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IAA (A-10000 Series)	A81-40833	A81-49982
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ENERGY

A Continuing Bibliography

With Indexes

Issue 32

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from October 1 through December 31, 1981 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

NASA Scientific and Technical Information Branch 1982
National Aeronautics and Space Administration
Washington, DC

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(32)) lists 1316 reports, journal articles, and other documents announced between October 1, 1981 and December 31, 1981 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The entries are arranged in eight major categories, with *IAA Entries* preceding *STAR Entries* in each category. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Five indexes -- subject, personal author, corporate source, contract number, and report number -- are included.

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Includes hydrogen production, storage, and distribution.

04 FUELS AND OTHER SOURCES OF ENERGY 627
Includes fossil fuels, nuclear fuels, geothermal, ocean thermal, tidal, and wind energy, and biomass energy production.

05 ENERGY CONVERSION 657
Includes thermomechanical, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors, magnetohydrodynamic generators, and fuel cells.

06 ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION 685
Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission.

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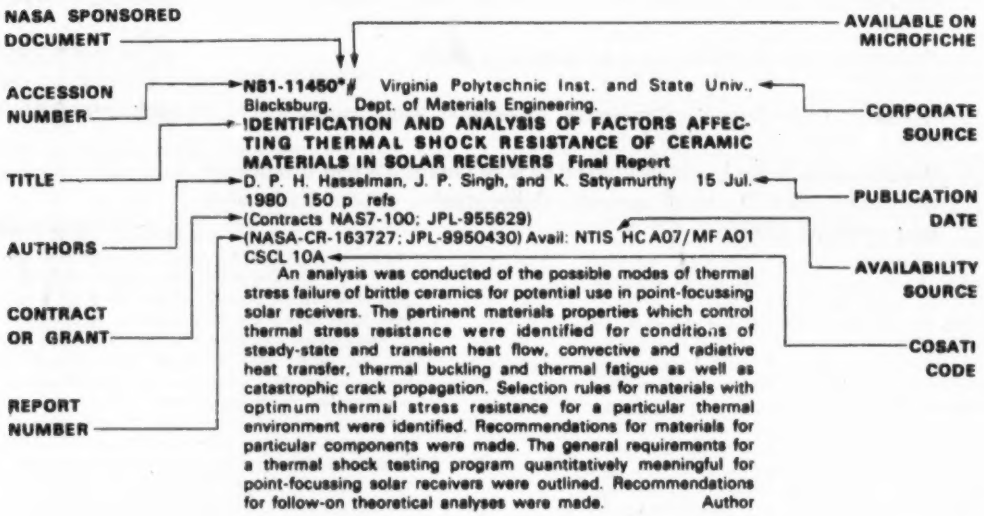
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N81-11450*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Materials Engineering.
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TITLE
IDENTIFICATION AND ANALYSIS OF FACTORS AFFECTING THERMAL SHOCK RESISTANCE OF CERAMIC MATERIALS IN SOLAR RECEIVERS Final Report
AUTHORS
D. P. H. Hasselman, J. P. Singh, and K. Satyamurthy 15 Jul. 1980 150 p refs
PUBLICATION DATE
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(Contracts NAS7-100; JPL-955629)
AVAILABILITY SOURCE
REPORT NUMBER
(NASA-CR-163727; JPL-9950430) Avail: NTIS HC A07/MF A01
COSATI CODE
CSCL 10A
An analysis was conducted of the possible modes of thermal stress failure of brittle ceramics for potential use in point-focussing solar receivers. The pertinent materials properties which control thermal stress resistance were identified for conditions of steady-state and transient heat flow, convective and radiative heat transfer, thermal buckling and thermal fatigue as well as catastrophic crack propagation. Selection rules for materials with optimum thermal stress resistance for a particular thermal environment were identified. Recommendations for materials for particular components were made. The general requirements for a thermal shock testing program quantitatively meaningful for point-focussing solar receivers were outlined. Recommendations for follow-on theoretical analyses were made. Author

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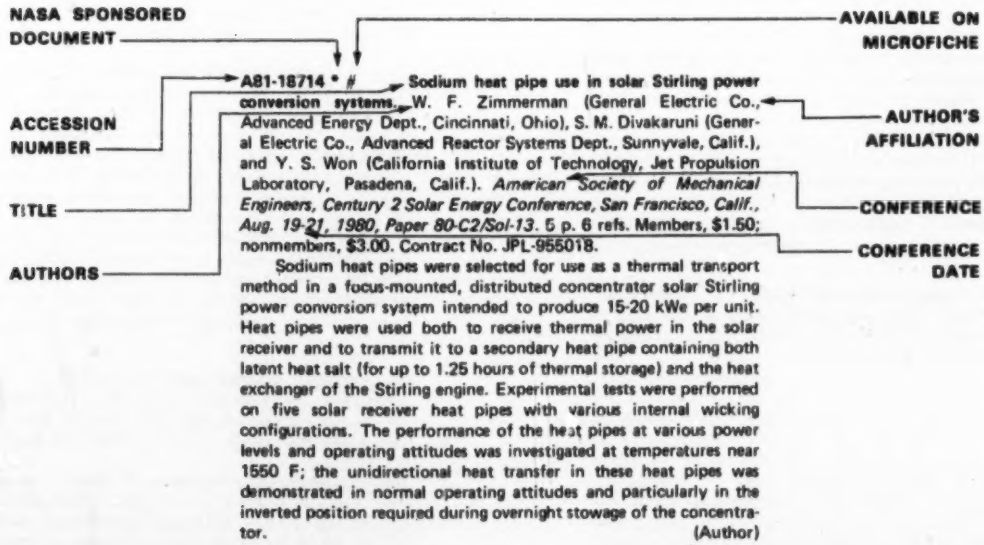
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A81-18714 * # Sodium heat pipe use in solar Stirling power conversion systems.
AUTHOR'S AFFILIATION
W. F. Zimmerman (General Electric Co., Advanced Energy Dept., Cincinnati, Ohio), S. M. Divakaruni (General Electric Co., Advanced Reactor Systems Dept., Sunnyvale, Calif.), and Y. S. Won (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).
TITLE
CONFERENCE
American Society of Mechanical Engineers, Century 2 Solar Energy Conference, San Francisco, Calif., Aug. 19-21, 1980, Paper 80-C2/Sol-13. 5 p. 6 refs. Members, $1.50; nonmembers, $3.00. Contract No. JPL-955018.
CONFERENCE DATE
AUTHORS
Sodium heat pipes were selected for use as a thermal transport method in a focus-mounted, distributed concentrator solar Stirling power conversion system intended to produce 15-20 kWe per unit. Heat pipes were used both to receive thermal power in the solar receiver and to transmit it to a secondary heat pipe containing both latent heat salt (for up to 1.25 hours of thermal storage) and the heat exchanger of the Stirling engine. Experimental tests were performed on five solar receiver heat pipes with various internal wicking configurations. The performance of the heat pipes at various power levels and operating attitudes was investigated at temperatures near 1550 F; the unidirectional heat transfer in these heat pipes was demonstrated in normal operating attitudes and particularly in the inverted position required during overnight stowage of the concentrator. (Author)

A Listing of Energy Bibliographies Contained In This Publication:

1. Gasahol sourcebook - Literature survey and abstracts --- Book p0632 A81-49452
2. Publications of the Jet Propulsion Laboratory 1980 p[illegible] J2 N81-29027
3. Advanced Technology Display House. Volume 4: Bibliography p0702 N81-31038
4. Development, testing, and evaluation of MHD materials and component designs. Volume 7: MHD appendix (bibliography, patent disclosures, supplementary DWGS) p0679 N81-33038

ENERGY

A Continuing Bibliography (Issue 32)

JANUARY 1982

01
ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Includes energy requirements, energy conservation, and environmental impacts of energy systems.

A81-41874 **Legal aspects of solar energy.** Edited by J. H. Minan (San Diego, University, San Diego, CA) and W. H. Lawrence. Lexington, MA, Lexington Books, 1981. 245 p. $23.95.

The objective of this book is to facilitate the realization of solar energy's potential through an analysis of the fundamental legal barriers that presently impede its widespread use. An overview of solar energy is provided and aspects of solar technology are examined, taking into account the sun, active solar-energy system, distribution, storage, applications, passive systems, the costs of solar systems, and the generation of electricity. Common-law doctrines and solar energy are considered along with a legislative approach concerned with questions of access to the sunlight, state and federal tax incentives to promote solar use, public and private methods of financing solar-energy devices, the relationship between utilities and solar energy, the limited role of warranties, and relations between oil companies and solar energy. An analysis is conducted of product standards, which hold great promise for overcoming user resistance, taking into account institutional barriers to solar commercialization, current solar standards development, and an evaluation of the significance of standards for solar-energy equipment. G.R.

A81-41875 **Synthetic fuels technology overview with health and environmental impacts.** E. J. Bentz, Jr. and E. J. Salmon. Research sponsored by the U.S. Environmental Protection Agency. Ann Arbor, MI, Ann Arbor Science Publishers, Inc., 1981. 136 p. 66 refs. $19.95.

An introduction is presented to the following synthetic fuels technologies: (1) the Lurgi gasification of coal; (2) the Fischer-Tropsch liquefaction of coal; (3) coal-methanol conversion; (4) donor solvent gas liquefaction; (5) Tosco surface shale retorting; ethanol production from coal; and (6) the coal-methanol-gasoline conversion process. After establishing the system characteristics of these six technologies, consideration is given to their potential major health, safety, environmental and socio-economic impacts at the global, regional and local levels. It is determined that the main global consequence of synfuels development is climate modification, to which may be added the regional impact of dry and wet deposition of gaseous and particulate pollutants, and land and water quality deterioration due to soil erosion at the local level. O.C.

A81-41904 **Geothermal energy projects - Planning and management.** Edited by L. J. Goodman (East-West Center, Honolulu, HI) and R. N. Love (Massey University, Palmerston North, New Zealand). New York and Oxford, Pergamon Press, 1980. 244 p. $33.

A presentation is made of management requirements for the development of geothermal resources by citing three major, and successful, projects: the Wairakei geothermal power project of New Zealand, the Hawaii geothermal project of the United States, and the Tiwi geothermal project of the Philippines. The three case studies are presented according to a format in which the history of each project falls into four phases: (1) planning, appraisal and design; (2) section, approval and activation; (3) operation, control and handover; and (4) evaluation and refinement. Each case study furnishes extensive performance and economic figures, along with consideration of such related issues as geothermal effluent chemical content, infrastructural requirements, and environmental impact. O.C.

A81-41905 **An introduction to geothermal energy.** L. J. Goodman (East-West Center, Honolulu, HI) and R. N. Love (Massey University, Palmerston North, New Zealand). In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 1-23. 7 refs.

A wide ranging introduction is given to the known resources and potential applications of geothermal energy. The discussion covers (1) the geological bases for the existence of heat flow and geothermal gradients in crustal plate boundaries; (2) the classification of resources into hydrothermal convection, hot igneous and conductive environment systems; (3) the approximate temperature requirements of geothermal fluids for various applications; (4) an inventory of residential, commercial, agricultural, food-processing and industrial users; (5) present and estimated electrical geneneration capacity for such rich geothermal resources as those of the U.S., Mexico, Turkey, Japan and Indonesia; and the four phases of the Integrated Project Planning and Management Cycle (IPPMC): comprising (1) planning, appraisal, and design; (2) selection, approval and activation; (3) operation, control and 'handover'; and (4) evaluation and refinement. O.C.

A81-41906 **Wairakei geothermal power project - New Zealand.** R. N. Love (Massey University, Palmerston North, New Zealand) and R. Bolton (Ministry of Works and Development, New Zealand). In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 24-94. 7 refs.

A comprehensive account is given to the development history of New Zealand's Wairakei geothermal power project. The project site was chosen because: (1) the area contained streams which could provide water needed for drilling operations; (2) the nearby Waikato River could provide an ample source of cooling water when electrical generation operations began; (3) the lands belonged to the government and no private interests would be affected; (4) the area was made up of unproductive wasteland; and (5) the location was isolated and would not detract from scenic attractions that are a major tourist resource in nearby areas. An extensive analysis is given of the capital costs factors influencing the project during its planning and design phase, and emphasis is put on the decision making relationships among government agencies with responsibility in the management of the program. O.C.

A81-41907 **Hawaii geothermal project - United States.** L. J. Goodman, B. Yount (East-West Center, Honolulu, HI), and T. Miyabara. In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 95-167. 21 refs.

An historical account is presented of the conduct of a major geothermal energy project on the island of Hawaii. Attention is given to the geophysical surveys and engineering and environmental-socioeconomic studies conducted at the outset, the mechanical principles of the vapor flashing and binary flashing plant design alternatives considered, the choice of plant locations, the design and construction of the geothermal well casing, and the extensive test program conducted upon the well's completion. Also detailed are the geothermal research test facility's estimated plant equipment costs, well performance figures, geothermal fluid chemical content, operation noise levels, and financial summary for the project over the period 1973-78. O.C.

A81-41906 **Tiwi geothermal project - The Philippines.** R. Aquino (De La Salle University, Manila, Philippines), S. Aquino (Philippine National Oil Co., Manila, Philippines), and A. Alcaraz. In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 168-205. 5 refs.

An account is given of the Philippines' Tiwi geothermal field development and related research projects. Among the topics covered are: (1) preliminary research studies throughout the Philippine archipelago, considering such potential sites as direct volcanic exhalations, shallow volcanic sources, deep-seated plutonic sources, and deep faulting in regions of high geothermal gradient; (2) fault systems detected by aerial photographic surveys, such as the plug-dome fault systems, radial fault systems, and arcuate fault systems; (3) performance figures on test drill holes at six different locations; (4) mechanical details of the Tiwi steam-gathering system; (5) the National Power Corporation's organization of responsibilities; and (6) detailed comparisons of energy demand, sources and their costs in the Philippines as seen by the Ten-Year Energy Program for the period 1979-88. O.C.

A81-41939 **Policies of geothermal development.** L. J. Goodman (East-West Center, Honolulu, HI) and R. N. Love (Massey University, Palmerston North, New Zealand). In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 206-222. 5 refs.

The case histories of (1) the Wairakei geothermal power project of New Zealand, (2) the Hawaii Geothermal project of the U.S., and (3) the Tiwi geothermal project of the Philippines are examined. It is argued that geothermal energy managers must be capable of accomplishing the following tasks: (1) coordination of resource exploration and evaluation, and the establishment of an optimum plant location; (2) the determination of the size of the resource and its hydrothermal and chemical characteristics; (3) designation of the site's civil improvements and plant module foundations; (4) design of the collection and reinjection system pipelines; (5) management of the procurement and detailed design of all modules and their interconnections; and (6) management of construction, activation, and training activities. O.C.

A81-42694 **Southern California Edison bets on energy alternatives.** W. B. Riley. *IEEE Spectrum*, vol. 18, Aug. 1981, p. 40-45. 5 refs.

A 10-MW solar-thermal generating plant and a 100-MW integrated coal-gasification combined cycle (IGCC) power facility are being built to develop a wide range of renewable, alternative power sources by 1990. The solar-thermal generating plant will use steam at 500 C and 100 kg/sq cm to produce 10 MW of electricity. It consists of a 1818 heliostat array, each weighing 1155 kg and having 12 mirrors which are rotated at either 0.25 deg/min (for sun following) or 22.5 deg/min (for major focusing and defocusing). A master control system allows both fully automatic and manual operation, and a beam-characterization system permits the operator to check the alignment of each heliostat individually. A central receiver, consisting of 24 panels of tubing, produces steam at 500 C and 100 kg/sq cm. The thermal storage unit uses crushed granite to absorb 50 kWht/cu m, allowing the plant to operate after sundown. The IGCC plant integrates the coal-gasification plant and the combined-cycle unit, demonstrating operational flexibility and reliability, load-following capability, and compliance with environmental regulations. The gasifier produces 79,300 cu m/h of a mixture of 51% CO and 36% H at 1370 C,and the gas turbine regenerates 65 MW through its own generator. J.F

A81-42720 **Topical problems of guideline editing with regard to emission control - Results and conclusions of a 1980 informative symposium by the VDI commission for clean air (Aktuelle Probleme der Richtlinienarbeit zur Emissionsbegrenzung - Ergebnisse und Folgerungen des Informationssymposiums 1980 der VDI-Kommission Reinhaltung der Luft).** J. Kölble. *Staub - Reinhaltung der Luft*, vol. 41, July 1981, p. 237-239. In German.

A81-42785 * **Development of simplified airborne computations for fuel conservative descents in a time-based metered air traffic environment.** C. E. Knox (NASA, Washington, DC). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 7-10, 1981, Paper 810642.* 18 p. 9 refs.

The NASA has developed and flight-tested a simple flight management descent algorithm designed to improve the accuracy of delivering an airplane in a fuel-conservative manner to a metering fix at a time designated by air traffic control. This algorithm provides a three-dimensional path with terminal area time constraints (four-dimensional) for an airplane to make an idle-thrust, clean-configured (landing gear up, flaps zero, and speed brakes retracted) descent to arrive at the metering fix at a predetermined time, altitude, and airspeed. The descent path is calculated for a constant Mach/airspeed schedule from linear approximations of airplane performance with considerations given for gross weight, wind, and nonstandard pressure and temperature effects. Applications of the four-dimensional and descent planning capabilities of the algorithm to conventional airplanes is being investigated. This report describes the flight management descent algorithm and presents the results of the flight tests flown with the Terminal Configured Vehicle airplane. (Author)

A81-42948 **The economics of synthetic fuels and chemicals production from nuclear power and from coal.** S. P. S. Andrew (Imperial Chemical Industries, Ltd., Agricultural Div., Billingham, Middx., England). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1653-1660.

The relative costs of production and likely prices for a number of important energy sources and basic chemicals are analysed in terms of future coal, oil and natural gas prices. It is concluded that Europe and Japan will be in a particularly difficult economic situation which can only be partially alleviated by a rapid expansion of nuclear power. The use of biomass as an energy source is not a practical solution in developed countries. (Author)

A81-43045 **Effects of synfuel use.** M. Ghassemi, R. Iyer, R. Scofield (TRW Energy Systems Group, Redondo Beach, CA), and J. McSorley (U.S. Environmental Protection Agency, Research Triangle Park, NC). *Environmental Science and Technology*, vol. 15, Aug. 1981, p. 866-873. U.S. Environmental Protection Agency Contract No. 68-02-3174.

The EPA sponsored an effort to investigate the environmental implications of a large-scale use of synfuel products. In forecasting the future of the synfuel product industry, it was shown that shale oil is more nearly cost-competitive and closer to commercialization than are high-Btu gasification and coal liquefaction, and will probably be used by 35% of all refinery feed and 48% of all middle distillate in the north-western region of the U.S.A by the year 2000. For the next two decades, environmental impacts will be confined primarily to synfuel production regions. Current environmental data are characterized in terms of gross properties, which do not provide an adequate basis for assessing environmental significance. Known differences in chemical, combustion, and health effects between synfuel products and their petroleum analogues are presented, showing the former to be more hazardous due to greater mutagenic, tumorigenic, and cytotoxic properties. Various synfuel products are also compared and ranked on their potential for exposure, emission, toxic hazard, cost of control, and adequacy of existing regulations. J.F.

A81-43157 # Wright Field turboprop study. R. C. Lorenzetti and P. P. Dull (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1685.* 6 p.

The considered investigation was conducted as part of an effort to reduce aircraft fuel costs. Turboprops are very fuel efficient at speeds below Mach 0.6. One of the most promising approaches to reduce fuel consumption in the speed range from Mach 0.6 to 0.8 is related to an employment of the swept eight to ten blade propeller (propfan) being developed by NASA. All studies to date indicate that turboshaft engines with propfans might save 15% or more of the fuel used by a turbofan engine of comparable technology. Attention is given to a turboprop status review, contractor studies, the NASA propfan program, an in-house performance study, specific problems which have to be solved to make a twin-turboprop, 100-150 passenger transport a viable possibility for the early 1990s, and turboprop dilemmas. G.R.

A81-43949 # A synopsis of the Navy A-7 Aircraft Fuel Conservation program. W. E. Mallett (Vought Corp., Dallas, TX) and M. Herskovitz (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1681.* 8 p. 8 refs.

A description is given of the Navy Aircraft Fuel Conservation program, with emphasis on fuel conservation methods devised for the A-7 aircraft. The fundamental elements of the program are reductions in (1) aircraft weight; (2) aerodynamic drag; (3) engine specific fuel consumption; and (4) fuel losses. Weight reduction is implemented through comprehensive use of plastic composite and titanium alloy secondary structures and accessories, and the incorporation of lighter subsystems (generator, radar, armor, etc.). Aerodynamic improvements include the application of fairings and fillets to various portions of the fuselage and wing. In addition, the efficiency of peripheral pneumatic and hydraulic systems' power extraction from the engine is increased through redesign. A description is given of the onboard Flight Performance Advisory System. O.C.

A81-44042 Boeing 767 - The new fuel saver. J. Marsden. *Flight International*, vol. 120, Aug. 8, 1981, p. 436-440, 442-448, 453.

A detailed introduction is given for the 767 airliner, which is intended to yield an 8.5% fuel reduction in 100-2000 n. mi. flights by comparison with the A310. Attention is given to such aspects of the aircraft as passenger accommodations, the extensive use of CRT displays for both electronic flight instrumentation and engine indication/crew alerting systems in the cockpit, advanced hydraulic, environmental control and electrical systems, the use of carbon and Kevlar-reinforced plastics, the airframe assembly sequence, and engine performance characteristics. Detailed dimensional data are presented, and a tentative list of airline orders and options is given showing a total of 173 orders and 138 options. Airline orders will differ in their choice of JT9D or CF6-80 engines. A cut-away section of the aircraft is included. O.C.

A81-44164 Contribution to the study of sulphur dioxide transformation in power plant plumes - Tests in laboratory and on flue gases of an oil-fired power plant. J. C. Sabroux, D. Vigla, G. Madelaine (Commissariat à l'Energie Atomique, Laboratoire de Physique de l'Atmosphère, Fontenay-aux-Roses, Hauts-de-Seine, France), G. Matfioln, and J. Dubois (Electricité de France, Département Environnement Aquatique et Atmosphérique, Chatou, Yvelines, France). *Atmospheric Environment*, vol. 15, no. 9, 1981, p. 1605-1613. 18 refs.

The reported study has the objective to determine the nature and speed of the transformations which take place in the exhaust gases of oil-fired power plants. An investigation was conducted of the reactions which take place in the plume shortly after emission (dilution factor less than 100), giving particular attention to the point of water vapor condensation. Laboratory experiments were conducted to study two distinct types of chemical reactions, including reactions in the homogeneous gaseous phase (with and without ultraviolet light) and reactions in the heterogeneous phase. A semidynamic simulation device was used for the experiment. The device consists of three elements, including an injection pipe, a smog chamber, and an exhaust stack. On the basis of the study results, it appears that a transformation of SO2 to SO3 must occur. G.R.

A81-44166 Particulate sulfate in Lexington, Kentucky and its relation to major surrounding SO2 sources. A. M. Hazrati and L. K. Peters (Kentucky, University, Lexington, KY). *Atmospheric Environment*, vol. 15, no. 9, 1981, p. 1623-1631. 25 refs.

An experimental study was conducted during 1979 and 1980 to establish the chemical composition and size distribution of the atmospheric aerosol in Lexington, Kentucky. The sulfate, nitrate, metal and acid contents of the total suspended particulate captured on Hi-Vol filters were measured. The daily average particulate sulfate concentration was relatively high (10-40 micrograms/cu m), even though there are no substantial sources of either SO2 or sulfate in the immediate Lexington area. Eighty per cent or more of the sulfate was contained in particles having an aerodynamic equivalent diameter of less than 1 micron. The results of air trajectory calculations were empirically correlated to relate the measured sulfate and total sulfur to the emissions from the 23 largest coal burning power plants in Kentucky, distance and time of transport, and relative humidity. The sulfate levels were proportional to the SO2 emissions from these sources and showed a strong inverse dependence on the plume travel distance. These factors are consistent with the formation of SO4(2-) in the atmosphere during transport. (Author)

A81-44174 Benzene, toluene and xylene concentrations in car exhausts and in city air. E. Hasanen, V. Karlsson, E. Leppamaki (Technical Research Centre of Finland, Esbo, Finland), and M. Juhala (Helsinki University of Technology, Helsinki, Finland). *Atmospheric Environment*, vol. 15, no. 9, 1981, p. 1755-1757. 10 refs. Research supported by the Academy of Finland.

A81-44278 # Air pollution control practices in large thermal power plants in India. N. C. Debnath (National Thermal Power Corp., Ltd., Operation Services Div., New Delhi, India). *Indian Journal of Environmental Protection*, vol. 1, Apr. 1981, p. 97-102.

The status of Indian thermal power plants, their emissions and health aspects, current practices in controlling the emissions of various air pollutants and difficulties encountered in maintaining the 'clean air' drive are briefly described. The NTPC-Super thermal power projects (STPP) and its role in this context have also been highlighted. With the current trend of accelerated development of coal fired STPP, it is apprehended that present control technology in India would far outweigh the demands, unless stringent control guidelines are legalized. (Author)

A81-44279 # Stack gas desulphurization recovery processes in thermal power plants of the world. II - Processes based on adsorption of SO2 on activated carbon. S. Kumar (Banaras Hindu University, Varanasi, India). *Indian Journal of Environmental Protection*, vol. 1, Apr. 1981, p. 103-109. 22 refs.

Processes in use at thermal power plants for the recovery of SO2 adsorbed on activated carbon in flue gas desulfurization are discussed. Attention is given to methods for adsorbent regeneration by heating to induce a reaction between the carbon and sulfuric acid to produce SO2 (the Chemiebau or Reiniluft and Bergbau-Forschung/Foster Wheeler processes), by washing with water to produce sulfuric acid solutions (the Lurgi or Sulfacid and Hitichi processes) and by the reaction with a reducing gas to produce elemental sulfur (the Westvaco process). A.L.W.

A81-44501 The temporal and spatial distribution of tropospheric nitrous oxide. R. F. Weiss (California, University, La Jolla, CA). *Journal of Geophysical Research*, vol. 86, Aug. 20, 1981, p. 7185-7195. 34 refs. NSF-supported research.

Nitrous oxide concentration measurements made in 1976-1980 aboard oceanographic vessels in the major world oceans show that the tropospheric nitrous oxide concentration is increasing by about 0.2% per year, with higher concentrations being detected in the northern rather than in the southern hemisphere. These data are well represented by a box model relating the tropospheric rate of increase to an exponentially increasing source function. According to the model projections, the concentration of tropospheric nitrous oxide in the year 2000 will be 5 to 7% above present values. The observed rate of tropospheric increase directly affects the production of stratospheric nitric oxide, playing a role in the earth's radiation balance that has been estimated conservatively as 10-15% of the effect due to increasing carbon dioxide. A substantial fraction of nitrous oxide production is attributable to the combustion of fossil fuels. O.C.

A81-44628 * Review of NASA programs in applying aerospace technology to energy. F. C. Schwenk (NASA, Office of Aeronautics and Space Technology, Washington, DC). In: Space - Enhancing technological leadership; Proceedings of the Twenty-seventh Annual Meeting, Boston, MA, October 20-23, 1980. San Diego, CA, American Astronautical Society; Univelt, Inc., 1981, p. 161-181. (AAS 80-718)

NASA's role in energy research and development, with the aid of aerospace technology, is reviewed. A brief history, which began in 1974 with studies of solar energy systems on earth, is presented, and the major energy programs, consisting of over 60 different projects, are described, and include solar terrestrial systems, conservation and fossil energy systems, and space utilization systems. Special attention is given to the Satellite Power System and the isolation of nuclear wastes in space. Emerging prospects for NASA programs in energy technology include bioenergy, and ocean thermal energy conversion, coal extraction and conversion technologies, and support to the nuclear industry in power plant systems safety. K.S.

A81-44635 Commercial operations in space - 1980-2000; Proceedings of the Eighteenth Goddard Memorial Symposium, Washington, DC, March 27, 28, 1980. Symposium sponsored by AAS, AIAA, AMA, et al. Edited by J. L. McLucas (Communications Satellite Corp., Washington, DC) and C. Sheffield (Earth Satellite Corp., Washington, DC). San Diego, CA, American Astronautical Society (Science and Technology Series. Volume 51); Univelt, Inc., 1981. 211 p. $30.

The need to revitalize American industry is considered along with questions of space industrialization, materials science and engineering in space, materials engineering in space, space power systems, earth resources, commercial launch operations, research opportunities, and international opportunities. Attention is given to the Space Shuttle power extension package, the orbital transfer of large space structures with nuclear electric rockets, a satellite power system overview of system studies and critical technology, electric orbit transfer vehicles, the mixed-mode principle and advanced chemical rocket engine concepts, crop reporting from space, the Space Industrialization Act and the government role in the commercialization of space, the airlines in the 80's and 90's, approaches to private sector involvement with government in technology development, innovation of space technology through joint endeavors between NASA and private industry, and the economic and political climate for exploitation of space riches. G.R.

A81-44668 * # Results from conceptual design study of potential early commercial MHD/steam power plants. F. Hals, R. Kessler, D. Swallom, L. Westra, J. Zar (Avco Everett Research Laboratory, Inc., Everett, MA), W. Morgan (Charles T. Main, Inc., Boston, MA), and C. Bozzuto (Combustion Engineering, Inc., Windsor, CT). *Magnetohydrodynamics Symposium, 19th, University of Tennessee, Tullahoma, TN, June 15-17, 1981, Paper.* 11 p. 5 refs. Research supported by the U.S. Department of Energy; Contract No. DEN3-51.

This paper presents conceptual design information for a potential early MHD power plant developed in the second phase of a joint study of such plants. Conceptual designs of plant components and equipment with performance, operational characteristics and costs are reported on. Plant economics and overall performance including full and part load operation are reviewed. Environmental aspects and the methods incorporated in plant design for emission control of sulfur and nitrogen oxides are reviewed. Results from reliability/availability analysis conducted are also included. (Author)

A81-44729 # Electric vehicle energy use simulation model. K. A. Stafford and A. R. DeWispelare (USAF, Institute of Technology, Wright-Patterson AFB, OH). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 544-548. 8 refs.

Electric vehicle propulsion systems are modeled in a driving cycle computer simulation. A very comprehensive vehicle model is used which includes aerodynamic drag, tire rolling resistance, rotational and translational inertia effects, and complete component by component power train efficiencies for varying load and speed. Battery discharge performance is tracked by a fractional-utilization method corrected for short-term prior discharge effects. The Federal Urban Driving Cycle was selected over the less rigorous SAE J227a electric vehicle test cycle to more accurately reproduce actual urban vehicle requirements and predict performance closer to actual vehicle user experience. The computer simulation outputs are used to determine optimized designs for minimum energy usage. An application for a typical suburban passenger vehicle is included. (Author)

A81-45274 Laser-radar signature-processing system. G. A. Bundell (Western Australia, University, Nedlands, Australia). *IEE Proceedings, Part F - Communications, Radar and Signal Processing*, vol. 128, pt. F, no. 4, Aug. 1981, p. 215-221. 11 refs. Research supported by the Western Australian Department of Conservation and Environment.

The analysis and presentation of ruby-laser-radar signatures in a particular application is examined. A complete system has been developed for this purpose, from acquisition of the return signal to contour presentation of target structures. In this case the target considered is an industrial plume emanating from a coal-fired power station. (Author)

A81-45904 Numerical study of local/regional atmospheric changes caused by a large solar central receiver power plant. C. M. Bhumralkar, A. J. Siemmons, and K. C. Nitz (SRI International, Menlo Park, CA). *Journal of Applied Meteorology*, vol. 20, June 1981, p. 660-677. 8 refs. Contract No. DE-AC03-78ET-20537.

A two-dimensional numerical atmospheric mesoscale model with a vertical cross section is applied to study the potential local/regional atmospheric effects of the installation of a 100 MWe solar thermal central receiver power plant in California. The plant comprises heliostats (mirrors) covering a portion of ground surface and reflecting sunlight onto a central receiving tower. The model is able to simulate the changes in surface characteristics associated with the installation of heliostats and other power plant ancillaries and can also simulate the effects of waste heat from cooling towers. The model equations are integrated to simulate typical summer and atypical summer. The results for typical summer conditions at the site and in the surrounding region demonstrate that the power plant has the potential to increase local humidity and wind circulation but cannot induce the formation of clouds or rain. The results for atypical summer conditions show that the solar power plant is potentially able to increase the wind circulation and form clouds and rain. It is noted, however, that the life cycle of such formations is only 2-3 h. C.R.

A81-45925 Synfuels and the energy transition. R. E. Balzhiser (Electric Power Research Institute, Golden, CO). *EPRI Journal*, vol. 6, July-Aug. 1981, p. 21-27.

Various synfuel options and their impact on the electric utility industry are discussed. The energy transition for the U.S.A. is seen as moving from natural fluid fuels to solid fuels and renewable energy resources. The key to this transition is electrification, which can encompass both nuclear and renewable resources, centralized and dispersed technologies. It is shown that the fraction of total energy converted to electricity has risen steadily for the past 30 years, reaching 33% last year. The abundance and cost of production of the various fossil energy resources, including natural gas, heavy oil, oil shale, and coal are considered. EPRI analyses indicate that an integrated-combined-cycle power plant could be competitive with conventional coal plant technology. These plants would use only half the water of current coal-fired plants, would meet tighter sulfur emission standards, and would produce a vitreous ash that is less leachable than the ash from today's coal plants. Solvent-refined coal processes, currently being developed in the U.S.A. are a second approach to converting coal to liquid fuels. It is pointed out, however, that synfuels will complement, not replace, other sources of energy in the continued electrification of the U.S.A. J.F.

A81-46465 Assessment of contemporary carbon combustion source contributions to urban air particulate levels using carbon-14 measurements. J. A. Cooper (Oregon Graduate Center, Beaverton, OR), L. A. Currie, and G. A. Klouda (National Bureau of Standards, Washington, DC). *Environmental Science and Technology*, vol. 15, Sept. 1981, p. 1045-1050. 23 refs. Research supported by the Oregon Dept. of Environmental Quality and NBS; U.S. Environmental Protection Agency Contract No. IAG-D6-E684.

The reported study had the objective to evaluate the use of carbon-14 as a unique tracer of emissions from burning vegetative material and to establish an upper limit to the contribution of residential wood burning and slash and field burning to air particulate levels in the Portland and Eugene airsheds. The use of C-14 as a unique tracer for vegetative emissions (natural emissions, forest fires, and field and slash burning) depends upon the absence of radiocarbon in fossil fuel and the presence of radiocarbon activity in the biosphere. Attention is given to measurement procedures, sample collection and selection, vegetative burn source apportionment, and residential wood combustion. The obtained results demonstrate for the first time the utility of radiocarbon as a unique tracer for emissions from burning vegetation. A consistent relationship has been developed between the fine-particle radiocarbon concentration and known source impacts such as field and slash burning and residential wood combustion. G.R.

A81-46466 Elemental composition of size-fractionated aerosols associated with a coal-fired power plant plume and background. L. E. Wangen (California, University, Los Alamos, NM). *Environmental Science and Technology*, vol. 15, Sept. 1981, p. 1080-1088. 11 refs. Research supported by the U.S. Department of Energy; U.S. Environmental Protection Agency Contract No. IAG-D5-0681.

A81-46467 Polychlorinated biphenyls in effluents from combustion of coal/refuse. J. J. Richard and G. A. Junk (U.S. Department of Energy, Ames Laboratory, Ames, IA). *Environmental Science and Technology*, vol. 15, Sept. 1981, p. 1095-1100. 24 refs. Contract No. W-7405-eng-82.

Polychlorinated biphenyls (PCBs) were observed in all of the effluents from an electrical power plant equipped to burn coal and mixtures of coal and refuse-derived fuel (RDF). Test combustions

with and without refuse were made, and no correlation could be established between the PCB content of any of the effluents and the fuel being combusted. The effluents studied were grate ash, fly ash, stack ash, stack gas, sluice water, and sluice sediment. The PCB content of the coal and RDF fuels and the air used to support the combustion were also measured. The fate of the average low PCB level of 0.1 microgram/cu m in this air could only be approximated. However, the appreciable amounts of PCBs which averaged 8500 micrograms/kg in the RDF were almost completely destroyed, leaving less than 1% to be distributed in the environment via stack emissions and disposal of grate and fly ash. The PCBs present in these ash effluents averaged less than 5 micrograms/kg. (Author)

A81-46476 **Life cycle problems and environmental technology; Proceedings of the Twenty-sixth Annual Technical Meeting, Philadelphia, PA, May 12-14, 1980.** Meeting sponsored by the Institute of Environmental Sciences. Mt. Prospect, IL, Institute of Environmental Sciences, 1980. 475 p. $25.

The conference focuses on the following key life cycle issues: specification, design and test in environmental integration; environmental test tailoring for electronic hardware; emerging technology in environmental testing and measurement; and contamination control in industry and bioscience. Other major issues discussed are: environmental strategy and economic balance, and the growing conflict between energy demands and environmental regulation. V.L.

A81-46786 **Comparison of prospective energy sources with those in use.** B. V. Voltsekhovskii. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Sept.-Oct. 1980, p. 118-125.) *Journal of Applied Mechanics and Technical Physics,* vol. 21, no. 5, Mar. 1981, p. 673-678. 17 refs. Translation.

The comparative physical-technical and economic characteristics of renewable energy sources are analyzed. The significant advantages of wind energy for future use over oil, gas, and coal are demonstrated. Costs of wind electrical energy are compared in the U.S., Denmark, and the U.S.S.R. A.T.

A81-47237 **Analysis and comparison of solar systems, heat pumps, and total-energy systems for low-temperature heat supply (Analyse und Vergleich von Solarsystemen, Wärmepumpen und Totalenergiesystemen zur Niedertemperaturwärmeversorgung).** D. Orth (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 127-136. In German.

An analysis is conducted of the conditions concerning the low-temperature heat supply in West Germany, taking into account a comparison of alternative heating systems with conventional approaches. It is found that, for an alleviation of energy-supply problems, energy-saving systems must become competitive in the area of one-family and two-family houses. However, only the electrical heat pump is currently competitive, and it is only competitive in comparison to oil heating. The use of solar energy systems is still not economical compared to an employment of heat pumps, if space-heating applications are considered. The competitive position of the new energy-saving systems is more favorable for multifamily houses. However, these houses can be supplied economically with heat by pipeline systems which transport heat over large distances. G.R.

A81-47246 **The Swedish wind energy program.** S. Hugosson. In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 399-405.

The National Swedish Board for Energy Source Development has implemented a program for wind energy research. Off-shore and sea coast conditions in Sweden offer a great potential for using wind energy; this potential is based on a totally integrated and highly balanced electrical supply system with a large proportion of hydropower. A large-scale, horizontal-axis wind turbine, equipped with two to three rotor blades will be used to demonstrate the technical and economic feasibility of wind energy. Full-scale prototypes of 2-10 MW size will be designed to produce reliable engineering data for future use. The design variations will be guided by criteria of high, slender tower; horizontal axis; two to three blades; and blade pitch control. A two-bladed, horizontal wind turbine with a rated power of 3 MW, a turbine diameter of 78 m, and cut-in and cut-out wind speeds of 6 m/sec and 21 m/sec, respectively, is one model already planned for in southern Sweden. J.F.

A81-47313 **A nuclear waste depot as a large platform in earth orbit.** H. O. Ruppe and D. Hayn (München, Technische Universität, Munich, West Germany). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-47.* 15 p. 6 refs.

The storing and disposal of high-activity nuclear wastes (HAW) in large structures at high earth orbit is considered to the end of the century and beyond. Among the topics discussed are: (1) the rate of accumulation of HAW on earth and at the space disposal station; (2) the projected growth of those rates of accumulation; (3) HAW payload launch schemes; (4) alternative nuclear waste disposal platform configurations; (5) lifetime mapping of long-lifetime orbits based on the 11-year mean solar cycle; and (6) the ultimate destination of nuclear waste disposal platforms. It is concluded that the additional cost to nuclear electricity consumers incurred by the implementation of a 1000-km altitude orbit platform scheme is 0.04 cents/kWh(e). The concept of the mass-driver is briefly covered, and various statistics concerning nuclear waste loads are given. O.C.

A81-47397 **Preliminary study results on possible space contribution to the solution of the world energy problems.** C. Poher (Centre National d'Etudes Spatiales, Paris, France). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-187.* 10 p.

The use of launch vehicles of the Ariane family for the long-term management of nuclear wastes is discussed. It is noted that because solar power satellites will not be economical in the near future, nuclear power will play a larger role. It is thought that the risks attendant upon space disposal will be reduced by advances in technology over the next 20 years, the period that will elapse before such disposal is attempted. C.R.

A81-47399 **Compact SPS - Environmental considerations.** M. Pospisil (Ceskoslovenska Akademie Ved, Astronomicky Ustav, Ondrejov, Czechoslovakia). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-194.* 7 p. 10 refs.

The effect on the environment of the production, transportation into orbit, and operation of space power stations (SPSs) is discussed. Methods are proposed for countering the effects seen as deleterious. For example, with regard to the operation of SPSs, it is suggested that more satellites be designated for each rectenna. With regard to the production of SPSs, it is noted that manufacture in space would not only preserve the environment but would also lower the costs of transporting the SPS into orbit. The harmful effects caused by the microwave transfer of energy from orbit to earth can be reduced by a proper choice of frequency, beam shape, power density, and time dependency of power during the day. C.R.

A81-47504 **EVC EXPO 80; Proceedings of the Third International Electric Vehicle Conference, St. Louis, MO, May 20-22, 1980.** Conference sponsored by the Electric Vehicle Council and European Electric Road Vehicle Association. Edited by L. Andrews (Electric Vehicle Council, Washington, DC). Washington, DC, Electric Vehicle Council, 1980. 605 p. $75.

Issues and trends in the case of electric vehicles are considered along with vehicle systems, EV fleet user experience, batteries, aspects of vehicle testing, EV commercial market and vehicle potentials, EV cost considerations, the effective utilization of EVs, and modeling, mission analysis, and impact assessment. Attention is given to EV component reliability, automatic gearshift control for an efficient battery vehicle drive system, a brushless DC motor-power conditioner unit designed and built for propulsion of electric passenger vehicles, a roadway powered electric vehicle system, inductively coupled power systems for electric vehicles, a fuel-cell-powered golf cart, electric vehicles in telephone service, electric vehicle use in the U.S. Postal Service, high performance electric commercial vehicles, nickel iron battery design and performance, the development of the nickel-iron-battery system for electric vehicle propulsion, the advancing performance threshold of the lead-acid

electric vehicle battery, advances in zinc bromine batteries for motive power, some aspects of battery vehicle evaluation with particular attention to a battery model, and a generic battery model for electric and hybrid vehicle simulation performance prediction. G.R.

A81-47843 **The relation between aircraft fuel reserves and navigation.** V. W. Attwooll (Civil Aviation Authority, London, England). *(Royal Institute of Navigation, Meeting, London, England, Jan. 21, 1981.) Journal of Navigation*, vol. 34, Sept. 1981, p. 437-449; Discussion, p. 450, 451.

A rational basis is presented for the determination of fuel uplift quantities in commercial operations, in relation to safety and regularity of services. Numerical models are devised as aids in estimating such factors as the regularity of service to be expected from a given fuel quantity uplifted at take-off, assuming that in-flight decisions about fuel usage are made in a rigid, automatic way. Navigation figures as an important element because all in-flight decisions demand exact knowledge of aircraft position. Attention is given the possible effects on fuel uplift policies of various changes and developments in aircraft equipment and air traffic control (ATC) systems; for instance: (1) the use of blind landing equipment of high reliability can influence a pilot's decision to continue holding or divert to an alternative landing site; and (2) airborne flight management systems are being developed to help the pilot implement fuel conservation through automatic estimates of the best speed and altitude to fly under given conditions, reducing fuel consumption by an estimated 1.6%. O.C.

A81-48117 **Turning to the wind.** B. Sorensen (Roskilde Universitetscenter, Roskilde, Denmark). *American Scientist*, vol. 69, Sept.-Oct. 1981, p. 500-508. 26 refs.

Consideration is given the economic and technological aspects of both free-stream (horizontal-axis) and cross-wind (vertical-axis) wind energy conversion systems, with attention to operational devices ranging in rotor diameter from 10 to 40 m and in output from 22 to 630 kW. After a historical survey of wind turbine design and applications development, the near-term technical feasibility and economic attractiveness of combined wind/fossil-fueled generator and wind/hydroelectric systems are assessed. Also presented are estimates of wind energy potential extraction in the U.S. and Denmark, the industrial requirements of large-scale implementation, energy storage possibilities such as pumped hydro and flywheels, and cost comparisons of electrical generation by large and small wind systems, coal-fired plants, and light-water fission reactors. O.C.

A81-48317 # **Possibilities of utilizing renewable energy sources.** I. Benko (Budapesti Muszaki Egyetem, Budapest, Hungary). *Periodica Polytechnica, Mechanical Engineering*, vol. 25, no. 1, 1981, p. 67-86. 7 refs.

Attention is given to the quantitative and structural changes that have occurred in man's consumption of energy. It is pointed out that today 90% of the energy used comes from nonrenewable sources. In considering renewable energy sources, such as the sun, winds, tides, river currents, and earth's heat, attention is given to their geographical distribution. It is noted that supplying energy to isolated settlements that do not possess sources of renewable energy will pose a challenge. C.R.

A81-48477 **Power in the year 2000 - Some reminiscences and forecasts.** T. E. Allibone. *Contemporary Physics*, vol. 22, Sept.-Oct. 1981, p. 545-558.

The forecasting of future electrical energy demands in Great Britain by the Central Electricity Generating Board, which is necessary in view of the long time needed to build a large power station, is discussed. Unexpected factors which invalidate electricity forecasts, such as the sudden fourfold increase in the price of oil in 1973 and the discovery of nuclear fission, are pointed out. Options for planning in 1981 are then considered, with attention given to the place of energy savings, a second generation of nuclear power plants, fusion power, district heating from generator steam, pumped storage, wind power, wave power, geothermal energy and magnetohydrodynamics. A tentative prediction is made that in 50 years, coal will no longer be burned, but extracted for use in the chemical industry. A.L.W.

A81-49630 **Energy from space - An imperative for international cooperation.** S. Gorove. *(Symposium on Space Law in Perspective, University of Mississippi, University, MS, Apr. 21, 1980.) Journal of Space Law*, vol. 9, Spring-Fall 1981, p. 41-44. 9 refs.

Problems associated with the internationalization of research and development regarding the solar power satellite program are examined. It is suggested that a careful assessment must be made of the pros and cons of internationalization with regard to the totality of the basic value and institutional processes rather than on the basis of a single value or institutional alternative. B.J.

A81-49876 **National Powder Metallurgy Conference Proceedings 1978-1979.** Edited by J. Hoffman (Cincinnati, Inc., Cincinnati, OH), W. Cebulak (Aluminum Company of America, Pittsburgh, PA), and E. Klar. Princeton, NJ, Metal Powder Industries Federation; American Powder Metallurgy Institute (Progress in Powder Metallurgy. Volumes 34 & 35), 1980. 439 p.

A status report on energy consumption and distribution in the P/M industry is presented and energy-saving applications of industrial gases are examined. Attention is given to designing sintering furnaces and atmospheres for energy savings, the use and application of miniature P/M parts, hot isostatic pressing of maraging steels, cold isostatic pressing of complex P/M shapes in the case of titanium and other special metals, the forming of P/M parts by consolidation at atmospheric pressure, and the preparation of binary and ternary alloys from mixed oxide ceramic preforms. The effects of particle size and density on the mechanical properties of sintered iron and iron/phosphorus alloys are considered along with predicting DC properties of P/M materials, P/M plates of hard-to-work materials, the characterization and processibility of high speed tool steel powders, and the graphite influence on P/M steel processing parameters. Other topics discussed are related to powders for plasma spray coatings, warm pressed alloys of copper with tin and tin-lead, a comparison of endothermic (generated) and nitrogen-based sintering atmospheres, and an advanced P/M material for high tensile, impact, and hardware applications. A description is provided of the surface porosity in P/M steel forgings, and the development and applications of heat-treated P/M steels containing manganese, chromium, vanadium, and molybdenum. G.R.

N81-28290# R and D Associates, Marina Del Rey, Calif.
RECOMMENDED RESEARCH ON LNG SAFETY Final Report, 1 Mar. 1979 - 31 Dec. 1980
H. J. Carpenter and F. R. Gilmore Mar. 1981 304 p refs
(Contract DE-AC03-79EV-10024)
(DOE/EV-10024/1; RDA-TR-111000-001) Avail: NTIS HC A14/MF A01

Although the modern liquefied natural gas (LNG) industry has enjoyed excellent success in providing for safe operations, significant questions remain on the part of many, the expressions of which were intensified with the addition of marine-based LNG import terminals. Public safety with regard to large scale importation of this fuel has received widespread attention in the U.S. Congress, state legislatures, county and city governments, and from various individuals and public groups, with coverage in all the news media, including books published on the subject. The safety concerns have centered around the consequences to the public of a large spill of the cryogenic liquid from an ocean tanker or a larger storage tank, either of which might hold as much as 125,000 cu m of LNG. DOE

N81-28291# Fluor Engineers and Constructors, Inc., Irvine, Calif.
ECONOMIC EVALUATION OF COAL GASIFICATION FOR ELECTRIC POWER GENERATION (AN UPDATE) Final Report
R. Beckman, W. Hsu, and J. Joiner Feb. 1981 188 p refs
Sponsored by EPRI
(EPRI Proj. 239-2)
(EPRI-AP-1725) Avail: NTIS HC A09/MF A01

This is an economic update of previous evaluations of various coal gasification and power generation systems. Capital and operating costs of all the systems were escalated to mid 1978 dollars from their original mid 1976 basis. The processes studied included the Lurgi dry ash gasifier; the British Gas Corporation's Slagger; the Texaco entrained system; Combustion Engineering's two stage entrained atmospheric pressure gasifier; Foster-Wheeler's two stage entrained pressurized system; and the Tosco/HRI Tosco-Dyne process. For comparative purposes, a coal fired steam electric generating station with stack gas desulfurize-

tion in subcritical and supercritical designs is also developd. The plant sizes used in all of the screening studies are in the capacity range of 1000 MW to 1200 MW. These plants feed a constant coal rate equivalent to 10,000 tons/day of Illinois No. 6 coal. Results indicate that the installed plant costs have escalated by elevent to 19 percent from mid 1976 plant investment costs. DOE

N81-28282# TRW Energy Systems Group, Morgantown, W. Va.
ECONOMIC ANALYSIS OF VERTICAL WELLS FOR COAL-BED METHANE RECOVERY
Arnold Snygg and William Fox Apr. 1981 62 p refs
(Contract DE-AC21-78MC-08089)
(DOE/MC-08089/107) Avail: NTIS HC A04/MF A01

Previous economic studies of the recovery and utilization of methane from coalbeds using vertical wells were based on drainage in advance of mining where a single seam is drained with well spacing designed for rapid predrainage. This study extends the earlier work and shows that methane recovery costs can be reduced significantly by increasing well spacing and draining multiple coalbeds. A favorable return on investment can be realized in many geologic settings using this method. Sensitivity of recovery economics to certain development costs and parametric variations are also examined as are the economics of three methane utilization options. DOE

N81-28303# Argonne National Lab., Ill. Energy and Environmental Systems Div.
IMPLEMENTATION PLANNING FOR INDUSTRIAL ENERGY CONVERSATION: APPROACH AND METHODOLOGY
T. G. Alston, G. Falk, P. J. Grogan, D. Katz, and J. Tatar Jan. 1981 46 p refs
(Contract W-7405-eng-38)
(ANL/CNSV-TM-55) Avail: NTIS HC A03/MF A01

Details of an industry-specific Conservation Technology Implementation Branch implemenation plan is described in detail. CTIB has conducted implementation planning in the steel, pulp/paper, and agriculture/food processing industries, but in FY 1981, CTIB plans to conduct planning for the chemicals, petroleum refining, aluminum, glass, cement, and textile industries. Guidelines are presented for each contractor for each industry toward a common methodology in terms of approach, areas of analysis, assumptions, and reporting. The major parts of the CTIB plan are: an implementation study consisting of technology selection, market demand analysis, and policy analysis, and a plan consisting of a detailed description and schedule of future CTIB actions, followed by a recommended system for monitoring market results when the plan is implemented. DOE

N81-28494 California Univ., Los Angeles.
THE FEASIBILITY OF USING SILVICULTURAL BIOMASS AS AN ALTERNATE FUEL: THE HANFORD RESERVATION CASE STUDY Ph.D. Thesis
John Isaac Baum 1981 153 p
Avail: Univ. Microfilms Order No. 8113815

An integrated silvicultural biomass plantation and infrastructure capable of producing a renewable supply of wood pellets. The capacity of the system is intended to replace the 78,000 metric tons per year (86,000 short tons per year) of coal currently used at the U.S. Department of Energy Richland Operation site (Hanford Reservation). The proposed 4,860 hectare (12,000 acre) plantation is located on the Hanford Reservation, adjacent to the Columbia River. The biomass plantation would be used for producing rapid growing hybrid Poplar trees, which would be intensely managed and harvested on a six year rotation cycle. Research, storage, transportation, and pelletizing facilities are also included in this concept. Results of the study indicate that it is technically feasible to design an integrated silvicultural/wood pelletizing facility at Hanford. As proposed, the plantation would require a large capital-intensive irrigation system. Based on a discounted cummulative net benefit analysis, the project will show a positive cash flow after 18 years. The net energy analysis indicate that six times more energy is produced than is utilized by the silvicultural plantation (i.e., 84 percent efficiency), which includes direct and indirect energy inputs. The environmental impact analysis indicates that there will be minimal adverse impacts. The major impact will be from the emission of small particulate matter from burning the wood (i.e., less than 10 microns). Overall, the net environmental impacts will be less than the coal, which is currently being used. Dissert. Abstr.

N81-28500# Texas Univ. at Arlington. Center for Energy Studies.
EASTERN EUROPE'S RESOURCE CRISIS, WITH SPECIAL EMPHASIS ON ENERGY RESOURCES: DEPENDENCE AND POLICY OPTIONS
George W. Hoffman Jan. 1981 68 p refs
(Policy-Study-14) Avail: NTIS HC A04/MF A01

The impact of Eastern Europe's energy resource shortages on its future economic and political development and its dependence on the Soviet Union as its main source of supply is examined. Tables show domestic production, imports, exports, and consumption for Bulgaria, Czechoslovakia, the GDR, Hungary, Poland, and Romania. A.R.H.

N81-28502# Texas Univ. at Arlington.
THE BANKING OF LIGNITE LEASES IN BASTROP COUNTY, TEXAS: 1954 - 1979
Christopher S. Davies and R. Wyatt Dietrich Aug. 1980 63 p refs
(Policy-Study-12) Avail: NTIS HC A04/MF A01

The forces that produce the pattern of lignite leasing and the effects of these contracts on the landowners and energy companies of Bastrop County are described. Disparities extraction costs, selling price, and the profits of companies and landowners are examined, as well as in the amounts allocated for aesthetic and functional rehabilitation of the landscape despoiled by strip mining. The attitude of landowners towards lignite mining were obtained by questionnaire and are analyzed using two- and three-stage models. The data presented attests to the unbalanced nature of the gains distribution resulting from lignite extraction and lend support to the idea that the energy companies should make a greater contribution to the rehabilitation of the land. A.R.H.

N81-28505# California Univ., Los Angeles. Lab. of Biomedical and Environmental Sciences.
VEGETATION MANAGEMENT AND RECOVERY AT SITES DISTURBED FOR SOLAR THERMAL POWER SYSTEMS DEVELOPMENT Progress Report
E. M. Romney, R. B. Hunter, and A. Wallace Feb. 1981 25 p refs
(Contract DE-AC03-76SF-00012)
(UCLA-12-1281) Avail: NTIS HC A02/MF A01

Disturbing land to develop energy producing technologies in Mojave Desert areas usually destroys existing shrub vegetation that cannot be repaired by natural restoration processes within the time frame required by environmental protection legislation. The primary effort of the vegetation management project during FY 1980 was directed toward the development of cost effective methods of restoring native vegetation on disturbed Mojave Desert land. Emphasis was placed upon improving techniques for producing transplanting stocks of native shrub species, investigating different ways to protect and encourage regrowth from crown sprouting and new seedling germination, developing improved transplanting methods, and searching for more practical means of conserving seasonal soil moisture necessary for the survival of new plant seedlings and transplanted specimens. DOE

N81-28522*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF INTEGRATED GASIFIER-COMBINED CYCLE AND AFB-STEAM TURBINE SYSTEMS FOR INDUSTRIAL COGENERATION
Joseph J. Nainiger, John M. Abbott, and Raymond K. Burns 1981 27 p refs Presented at 16th Intersoc. Energy Conversion Engl. Conf., Atlanta, 9-14 Aug. 1981; sponsored by ASME
(NASA-TM-82648; E-906) Avail: NTIS HC A03/MF A01 CSCL 10B

In the cogeneration technology alternatives study (CTAS) a number of advanced coal fired systems were examined and systems using a integrated coal gasifier IGCC or a fluid bed combustor AFB were found to yield attractive cogeneration results in industrial cogeneration applications. A range of site requirements and cogeneration sizing strategies using ground rules based on CTAS were used in comparing an IGCC and an AFB. The effect of time variations in site requirements and the sensitivity to fuel and electricity price assumptions are examined. The economic alternatives of industrial or utility ownership are also considered. The results indicate that the IGCC system has potentially higher fuel and emission savings and could be an attractive option for utility ownership. The AFB steam turbine system has a potentially higher return on investment and could be attractive assuming industrial ownership. A.R.H.

N81-28557# Oak Ridge National Lab., Tenn. Energy Div.
POTENTIAL FOR DISTRICT HEATING: AN HISTORICAL OVERVIEW
Martin A. Broders Mar. 1981 25 p Presented at the District Heating Tech. Training Workshop, Washington, D.C., 1-3 Apr. 1981
(Contract W-7405-eng-26)
(CONF-810435-1) Avail: NTIS HC A02/MF A01

An introduction to district heating is outlined. Attention is focused on the potential of district heating to meet the nation's energy conservation, environmental and social objectives. Basic terms are defined and the principal of district heating operation is described. District heating thermal energy sources, transport and distribution piping, and consumer secondary heating systems are discussed in general terms. A brief historical overview is presented. The history and status of district heating in Europe are also summarized. The advantages of district heating are outlined, and the primary factors that impeded the implementation of district heating in the US are discussed. DOE

N81-28558# Oak Ridge National Lab., Tenn. Energy Div.
ENERGY ISSUES RELEVANT TO DOMED CITIES. WINOOSKI, VERMONT: A CASE STUDY
Robert E. Gant 1980 15 p refs Presented at 1st Intern. Dome Symp., Winooski, Vt., 27 Mar. 1980
(Contract W-7405-eng-26)
(CONF-8003107-2) Avail: NTIS HC A02/MF A01

Enclosing all or a significant portion of a small urban community within a large secondary building envelope (dome) was examined as a potential alternative energy strategy. The concept of secondary envelopes as a community level energy strategy is discussed. Five alternative energy strategies are presented which might be less costly and technically complex than an urban envelope. The alternatives focused upon local options and resources to affect reductions in total energy consumption and scarce fuels. Insulation and use of efficient appliances, hydroelectric development, installation of cogeneration/district heating systems, use of solar technologies, and combinations of technologies are discussed. The alternatives represent examples of the opportunities available to local governments to exercise a degree of control over the community's energy future. DOE

N81-28572# Argonne National Lab., Ill.
COMPARATIVE HEALTH AND SAFETY ASSESSMENT OF ALTERNATIVE FUTURE ELECTRICAL GENERATION SYSTEMS
L. J. Habegger, J. R. Casper, and C. D. Brown 1980 7 p refs Presented at the Intern. Symp. on Alternative Energy Sources and Technol., Montreal, 28-30 May 1980
(Contract W-31-109-eng-38)
(CONF-800567-8) Avail: NTIS HC A02/MF A01

An analysis is made of health and safety risks of seven alternative electrical generation systems, all of which have potential for commercial availability in the post 2000 timeframe. The systems are compared on the basis of expected public and occupational deaths and lost workdays per year associated with 1000 MWe average unit generation. Risks and their uncertainties are estimated for all phases of the energy production cycle; including fuel and raw material extraction and processing, direct and indirect component manufacture, on site construction, and system operation and maintenance. DOE

N81-28578# Southwest Research and Development Co., Las Cruces, N. Mex.
ECONOMICS OF WIND ENERGY FOR IRRIGATION PUMPING Final Report
R. R. Lansford, R. J. Supalla, J. R. Gilley, and D. L. Martin 14 Jul. 1980 89 p refs Sponsored in part by Dept. of Agriculture
(Contracts DE-A101-76ET-20319; EX-76-A-29-1026)
(DOE/SEA-7315-2074/81/2) Avail: NTIS HC A05/MF A01

The economic questions associated with wind power as an energy source for irrigation under different situations with seven regions of the nation were studied. Target investment costs for wind turbines used for irrigation pumping and policy makers with bases for adjusting taxes to make alternative sources of energy investments more attractive are analyzed. Three types of wind systems are considered for each of the seven regions. The three types of wind powered irrigation systems evaluated for each region are: (1) wind assist combustion engines (diesel, natural gas, propane panel); (2) wind assist electric engines, with or without sale of surplus electricity; and (3) stand alone reservoir systems with gravity flow reservoirs. DOE

N81-28579# California Univ., Livermore. Lawrence Livermore Lab.
CALIFORNIA ENERGY FLOW IN 1979
C. K. Briggs and I. Y. Borg 31 Mar. 1981 18 p refs
(Contract W-7405-eng-48)
(UCID-18991) Avail: NTIS HC A02/MF A01

Energy use in California during 1979 differed significantly from 1978. Overall use of natural gas in the state increased substantially (14.3%) due principally to greater use for electrical power production; 4% more gas was used for electrical power generation in 1979 than in 1978 and 21% more than in 1977. Use of fuel oil for electrical generation remained at the 1978 level but below the high 1977 level, which reflected substitution of oil for hydroelectric power during the 1976 to 1977 drought. Together, oil and gas accounted for 80% of the fuels used to generate electricity. Crude-oil imports principally from Indonesia fell substantially; however, use of Alaskan North Slope oil increased so that the net increase in crude oil use was up about 4%. The transportation end-use sector consumed about as much as in 1978 despite shortages in early 1979 associated with the Iranian revolution. While sales fell slightly, sales of high-sulfur residual oils (Bunker C) increased markedly. Transportation represents 38% of total energy consumption in California. DOE

N81-28582# Stanford Univ., Calif. Dept. of Operations Research.
ETA-MACRO: A USER'S GUIDE
A. S. Manne Feb. 1981 138 p
(EPRI Proj. 1014)
(EPRI-EA-1724) Avail: NTIS HC A07/MF A01

The ETA-MACRO model is designed to estimate the extent of two way linkage between the energy sector and the balance of the economy. It represents a merger between ETA (a process analysis for energy technology assessment) together with a macroeconomic growth model providing for substitution between capital, labor, and energy inputs. The ETA-MACRO allows explicitly for: (1) energy economy interactions; (2) cost effective conservation; (3) interfuel substitution, and (4) new supply technologies, each with its own difficulties and uncertainties on dates and rates of introduction. This user's guide includes an overview of the model, an illustrative application to long term US energy projections, and technical descriptions of the macro and ETA submodels. It also includes an analysis of how market penetration rates may be related to the profitability of new technologies. Finally, the appendices provide a detailed guide to the computer implementation. DOE

N81-28590# Public Technology, Inc., Washington, D. C.
LOCAL GOVERNMENT GUIDE TO THE EMERGING TECHNOLOGIES OF COGENERATION AND PHOTOVOLTAICS. ENERGY TECHNOLOGY REPORT OF THE ENERGY TASK FORCE OF THE URBAN CONSORTIUM
1980 44 p refs Prepared in cooperation with Planning and Management Associates of Greater Washington, Inc., Washington, D.C.
(Contract DE-FG02-78IR-05108)
(DOE/IR-05108/T24) Avail: NTIS HC A03/MF A01

An overview of cogeneration and photovoltaic systems is presented to provide local government managers a basic understanding of the technologies. Issues and considerations associated with applications are presented. Discussions cover installation and maintenance requirements, equipment availability, costs, and risks/benefits. Data describing demonstration sites and contacts for further information are provided. DOE

N81-28596# Massachusetts Building Code Commission, Boston.
ENERGY-CONSERVATION OPPORTUNITIES IN LIGHTING
Apr. 1981 34 p
(Contract DE-FG01-79CS-60467)
(DOE/CE-60467-02) Avail: NTIS HC A03/MF A01

Technologies and techniques employed to reduce lighting costs by as much as 70 percent are discussed. Four basic steps to reduce energy costs and improve the effectiveness of the lighting system discussed are: (1) acquaintance with some of the basic terminology and energy efficient lamps and fixtures which are on the market; (2) conducting a survey of the building to determine where and how much energy and money can be saved; (3) implementation of the simple, low cost or no cost measures; and (4) calculation of the payback period for capital investment modifications, and implementation. DOE

N81-28622# Greater Caribbean Energy and Environment Foundation, Inc., Key Biscayne, Fla.
GREATER CARIBBEAN ENERGY AND ENVIRONMENT FUTURE. AD HOC WORKING GROUP REPORT
Anitra Thorhaug, ed. 1980 20 p refs Presented at Key Biscayne, Fla., 26-28 Oct. 1980; sponsored in part by Florida International Univ.
(Contract FG-01-80EV-10454)
(DOE/EV-10454/T1) Avail: NTIS HC A02/MF A01

The process by which environmental assessments by tropical experts can be successfully integrated into energy decisions is by: international loan institutions requiring or strongly recommending excellent assessments; engineering awareness of total effects of energy projects; governmental environmental consciousness-raising with regard to natural resource value and potential inadvertent and unnecessary resource losses during energy development; and media participation. Research tasks for today and twenty years hence, needed research, demonstration and information dissemination projects to get knowledge about Caribbean energy-environment used, and recommendation are presented. DOE

N81-29031# Texas Univ. at Arlington. Center for Energy Studies.
AN ANALYSIS OF FINANCIAL AND REGULATORY MODELS OF ELECTRIC UTILITIES
Alicia Torre Apr. 1981 62 p refs
(RR-12) Avail: NTIS HC A04/MF A01

Five financial and regulatory models were analyzed in terms of their use in a larger modelling project to measure conservation impact on utilities (CIUS). The five models are the Over/Under Capacity Planning Model (Over/Under), the Regulatory Analysis Model (RAM), the Electric Utility Policy and Planning Analysis Model (EPPAM), the Regionalized Electricity Model (REM), and the electric and Gas Utility Financial Simulation Model (ELFIN). No matter which model is used, certain modifications are necessary for use with CIUS. T.M.

N81-29032# Texas Univ. at Arlington. Center for Energy Studies.
A PRELIMINARY ANALYSIS OF THE NATURAL GAS MARKET-ORDERING PROBLEM
Robert C. Means Feb. 1981 133 p refs
(Policy-Study-15) Avail: NTIS HC A07/MF A01

Application of microeconomic analysis to the provisions of the Natural Gas Policy Act predict that partial deregulation of natural gas in 1985 will result in price discontinuity, misdirected benefits, and market raiding. The principal factual issues that must be resolved in any full assessment of this market ordering problem are considered. A.R.H.

N81-29038*# Cleveland State Univ., Ohio. Dept. of Electrical Engineering.
MINIMUM FUEL CONTROL OF A VEHICLE WITH A CONTINUOUSLY VARIABLE TRANSMISSION Final Technical Report, 1 Oct. 1978 - 30 Jun. 1980
James H. Burghart and John F. Donoghue 30 Jun. 1980 94 p refs
(Grant NsG-3223)
(NASA-CR-164587) Avail: NTIS HC A05/MF A01 CSCL 13F

The design and evaluation of a control system for a sedan with a heat engine and a continuously variable transmission, is considered in a effort to minimize fuel consumption and achieve satisfactory dynamic response of vehicle variables as the vehicle is driven over a standard driving cycle. Even though the vehicle system was highly nonlinear, attention was restricted to linear control algorithms which could be easily understood and implemented demonstrated by simulation. Simulation results also revealed that the vehicle could exhibit unexpected dynamic behavior which must be taken into account in any control system design. A.R.H.

N81-29039# California Univ., Livermore. Lawrence Livermore Lab.
ESTIMATES OF THE COST AND ENERGY CONSUMPTION OF ALUMINUM-AIR ELECTRIC VEHICLES
J. F. Cooper Nov. 1980 85 p refs Presented at the Fall Meeting of the Electrochem. Soc., Hollywood, Fla., 5 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-84445; CONF-8010159-1) Avail: NTIS HC A05/MF A01

Economic costs and primary energy consumption are estimated for general purpose electric vehicles using aluminum-air propulsion batteries within the time frame of the 1990's (earliest possible date of introduction). The results show that for a 40 kW, 70 kWh battery used in a vehicle traveling 16,000 km/y, the total capital investment in electricity and aluminum production plants and fuels distribution system was 2250 dollars or 32 dollar sq/kWh. Of this, the aluminum plants contributed 60 percent, and the fuels distribution system, 3 percent (less than 1 dollar/kWh). The introduction of 1,000,000 vehicles per year in 1995 would increase domestic aluminum demand by below 5 percent per year, and electricity demand by less than 0.2 percent per year. DOE

N81-29217# Massachusetts Inst. of Tech., Cambridge.
ASSESSMENT OF THE MAGNESIUM PRIMARY PRODUCTION TECHNOLOGY Final Report
Merton C. Flemings, George B. Kenney, D. R. Sadoway, Joel P. Clark, and Julian Szekely 1 Feb. 1981 180 p refs
(Contracts DE-AC01-76CS-40284; EX-76-A-01-2295)
(DOE/CS-40284/T1) Avail: NTIS HC A09/MF A01

At current production levels, direct energy savings achievable in primary magnesium production are 1.2 milliquads of energy per annum. Were magnesium to penetrate the automotive market to an average level of 50 pounds per vehicle, the resultant energy savings at the production stage would be somewhat larger, but the resulting savings in gasoline would conserve an estimated 325 milliquads of energy per year. The principal barrier to more widespread use of magnesium in the immediate future is its price. A price reduction of magnesium of 10% would lead to widespread conversion of aluminum die and permanent mold castings to magnesium. This report addressed the technology of electrolytic and thermic magnesium production and the economics of expanded magnesium production and use. DOE

N81-29242# Department of Energy, Bartlesville, Okla. Energy Technology Center.
DESIGN AND TESTING OF A PROCEDURE FOR EVALUATING FUEL-EFFICIENT CRANKCASE LUBRICANTS
T. M. Naman Apr. 1981 15 p refs
(DOE/BETC/RI-81/2) Avail: NTIS HC A02/MF A01

Experiments were conducted to design a procedure for evaluating the fuel efficiency characteristics of crankcase lubricants using the driving cycles of the 1975 Federal Test Procedure and the Highway Fuel Economy Test. Three crankcase lubricants and five oil supplements, as well as a baseline lubricant, were used in eight 1980 model year vehicles of identical make. The vehicles were operated at 750 F in closely controlled chassis dynamometer tests designed to detect small changes in fuel efficiency. Results from these tests showed measurable increases in fuel economy of 0 to 6 percent with the test lubricants when compared to a common SAE 30 grade oil. These results are not definitive because of lack of quantification of mileage accumulation effects. The test protocol did reduce measurement variability greately; this procedure can be applied to evaluatin of fuel efficient oils using larger test fleets. A good potential exists for improving the fuel economy of the U.S. automotive fleet. GRA

N81-29265# Decision Analysis Corp., Annandale, Va.
ALTERNATIVE-FUEL PRICE TRAJECTORIES: PREPARATION OF MFBI SIZE/USAGE OVERLAYS AND NEW BOILER ORDER ANALYSIS. SUBTASK 3.3 Final Report
15 Jun. 1981 253 p Sponsored in part by JWK International Corp.
(Contract DE-AC01-80RG-10446)
(DOE/RG-10446/T2) Avail: NTIS HC A12/MF A01

Results of a detailed statistical analysis of boiler unit size and capacity factor distributions by standard industrial classification (SIC) code and fuel type are presented. This analysis is based on data from the 1975 Survey of major fuel-burning installations (MFBI's). A comparative analysis of new boiler orders are also presented. The purpose of the comparative analysis is to identify emerging trends in boiler unit size distributions by fuel type relative to the MFBI data for 1974. The principal findings of the MFBI analysis are discussed. The results of analysis of the new boiler order data are discussed, and some conclusions, relevant to implementation of provisions of the Fuel Use Act of 1978 concerning boiler conversions to coal are presented. DOE

N81-29299# Battelle Pacific Northwest Labs., Richland, Wash.
CONSERVING ENERGY IN NEW BUILDINGS: ANALYSIS OF NONREGULATORY POLICIES
R. M. Scheer, L. A. Nieves, and R. P. Mazzucchi May 1981 70 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3820) Avail: NTIS HC A04/MF A01

Nonregulatory program alternatives identified are: information and education programs, tax incentives and disincentives, and mortage and finance programs. Surveys data to assess present public awareness of energy issues and energy-efficient building design were reviewed. Homebuyer and homebuilder surveys were reviewed and conservation motivations are discussed. The provision of technical and economic information to various factors affecting building design decisions were examined. This approach assumes that the economic incentives and technical means to achieve energy conservation goals already exist but that critical information is lacking. DOE

N81-29457# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch.
EMISSIONS AND FUEL ECONOMY OF THE AUTOMOTIVE CYLINDER DEACTIVATOR SYSTEM (ACDS)
Edward Anthony Barth Oct. 1980 40 p refs
(PB81-177958; EPA-AA-TEB-81-7) Avail: NTIS HC A03/MF A01 CSCL 13F

By operating an engine on a reduced number of cylinders and operating these at high power levels, throttling losses are appreciably reduced. The operating cylinders are run at a high brake-mean-effective pressure (BMEP) and, therefore, potentially more efficiently. Test results showing both emissions and fuel economy are presented for a cylinder deactivator. GRA

N81-29539# Centec Consultants, Inc., Reston, Va.
ENERGY CONSERVATION IN ETHANOL PRODUCTION FROM RENEWABLE RESOURCES AND NON-PETROLEUM ENERGY SOURCES
Mar. 1981 63 p refs Sponsored in part by A. Smith Bowman Distillery
(Contract DE-AC01-80CS-40352)
(DOE/CS-40352/T2) Avail: NTIS HC A04/MF A01

The dry milling process for the conversion of grain to fuel ethanol is reviewed for the application of energy conservation technology, which will reduce the energy consumption to 70,000 Btu per gallon, a reduction of 42 percent from a distilled spirits process. Specific energy conservation technology applications are outlined and guidelines for the owner/engineer for fuel ethanol plants to consider in the selection on the basis of energy conservation economics of processing steps and equipment are provided. Steps discussed are mash preparation and cooking, fermentation, distillation, and distillers dried grains processing. The economics of cogeneration of fuel ethanol plants is also studied. DOE

N81-29545# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
THIN FILM BATTERY/FUEL CELL POWER GENERATION SYSTEM. TOPICAL REPORT COVERING TASK 5: THE DESIGN, COST AND BENEFIT OF AN INDUSTRIAL COGENERATION SYSTEM, USING A HIGH TEMPERATURE SOLID OXIDE ELECTROLYTE (HTSOE) FUEL CELL GENERATOR
E. F. Federmann, A. O. Isenberg, W. A. Summers, and E. J. Vidt 25 Feb. 1981 59 p refs
(Contracts DE-AC02-76ET-11305; EY-76-03-1197)
(DOE/ET-11305/T8) Avail: NTIS HC A04/MF A01

A literature search and review of the studies analyzing the relationship between thermal and electrical energy demand for various industries and applications resulted in several applications affording reasonable correlation to the thermal and electrical output of the HTSOE fuel cell. One of the best matches was in the aluminum industry, specifically, the Reynolds Aluminum Production Complex near Corpus Christi, Texas. Therefore, a preliminary design of three variations or a cogeneration system for this plant was effected. The designs were developed to the extent necessary to determine technical practicality and economic viability, when compared with alternate conventional fuel (gas and electric) prices in the year 1990. DOE

N81-29548*# Argonne National Lab., Ill.
ASSESSMENT OF A SATELLITE POWER SYSTEM AND SIX ALTERNATIVE TECHNOLOGIES
T. Wolsko, R. Whitfield, M. Samsa, L. S. Habegger, E. Levine, and E. Tanzman Apr. 1981 230 p refs
(Contract W-31-109-eng-38)
(NASA-CR-164598; DOE/ER-0099) Avail: NTIS HC A11/MF A01 CSCL 10A

The satellite power system is assessed in comparison to six alternative technologies. The alternatives are: central-station terrestrial photovoltaic systems, conventional coal-fired power plants, coal-gasification/combined-cycle power plants, light water reactor power plants, liquid-metal fast-breeder reactors, and fusion. The comparison is made regarding issues of cost and performance, health and safety, environmental effects, resources, socio-economic factors, and institutional issues. The criteria for selecting the issues and the alternative technologies are given, and the methodology of the comparison is discussed. Brief descriptions of each of the technologies considered are included. DOE

N81-29551# Department of Energy, Washington, D. C. Assistant Secretary for International Affairs.
INTERNATIONAL ENERGY INDICATORS
R. M. Weiss, ed. May 1981 30 p
(DOE/IA-0010/11) Avail: NTIS HC A03/MF A01

Tabulated data and graphic displays are presented for: world crude oil production for each year since 1974; OPEC crude oil production capacity; world crude oil and refined product inventory level for each year since 1975; oil consumption in CECD Countries for each year since 1975; USSR crude oil production for each year since 1975; and the free World and US nuclear electricity generation for 1973 and the current capacity. Also, tabulated data and graphic displays are included on: US domestic oil supply for each year since 1977; US gross imports of crude oil and products for each year since 1973; landed cost of Saudi crude in current and 1974 dollars; US coal trade for each year since 1975; US natural gas trade for each year since 1975; a summary of US merchandise trade for each year since 1977; and the US energy/GNP ratio in 1972 dollars. DOE

N81-29554# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Engineering.
DIRECT EFFICIENCY MEASUREMENT AND CHARACTERIZATION OF RESIDENTIAL HEATING EQUIPMENT Annual Report, fiscal year 1979
R. F. Krajewski, R. J. McDonald, and J. S. Milau May 1980 77 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51242) Avail: NTIS HC A05/MF A01

Preliminary characterization results for hydronic (hot water) oil fired systems are presented. Results from the fully operational warm air furnace test facility and a description of the equipment and the technique used in measuring furnace efficiencies are included. Laboratory data were used to determine annual fuel consumption and fuel weighted seasonal efficiency for each heating unit based on typical operating parameters (size of residence, geographic location, and usage). A range of hydronic burner boiler systems are evaluated. The combination of direct, accurate efficiency measurement and calculation of annual fuel use provides a standard method for comparison of individual heating units and retrofit modifications on a common and realistic basis. DOE

N81-29560# Wilson-Hill Associates, Inc., Washington, D.C.
METHODS FOR EVALUATING AND RANKING TRANSPORTATION ENERGY CONSERVATION PROGRAMS Final Report
Louis C. Santone 30 Apr. 1981 111 p refs
(Contract DE-AC01-80CS-50226)
(DOE/CS-50226/1) Avail: NTIS HC A06/MF A01

The energy conservation programs are assessed in terms of petroleum savings, incremental costs to consumers probability of technical and market success, and external impacts due to environmental, economic, and social factors. Three ranking functions and a policy matrix are used to evaluate the programs. The net present value measure which computes the present worth of petroleum savings less the present worth of costs is modified by dividing by the present value of DOE funding to obtain a net present value per program dollar. The comprehensive ranking function takes external impacts into account. Procedures

are described for making computations of the ranking functions and the attributes that require computation. Computations are made for the electric vehicle, Stirling engine, gas turbine, and MPG mileage guide program. DOE

N81-29561# Oak Ridge National Lab., Tenn. Engineering Technology Div.
US INDUSTRIAL THERMAL ENERGY STORAGE PROGRAM
Mitchell Olszewski 1981 14 p refs Presented at Intern. Symp. on Energy Storage, Brighton, England, 29 Apr. 1981
(Contract W-7405-eng-26)
(CONF-810463-1) Avail: NTIS HC A02/MF A01

Three major programs to reduce oil and gas consumption in industry are described. The programs include in-plant reuse of industrial reject heat, external reuse of industrial reject heat, and the use of alternate fuels. Projects, the organization of the US Industrial Thermal Energy Storage Program, and future program directions are described with some specifics cited in the food processing and paper industries. DOE

N81-29570# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY FUTURES TO PROVIDE A CONTEXT FOR ENERGY R AND D
Glenn C. Werth, Barney Rubin, Richard A. Heckman, David W. Dorn, Carl J. Anderson, and Robert B. Bell 21 Apr. 1981 55 p refs
(Contract W-7405-eng-48)
(UCRL-53140) Avail: NTIS HC A04/MF A01

The constant evolution of energy which poses concerns for organizations carrying out energy R and D is discussed. Managers of such organizations need a context for assessing the evolution to judge the possible roles for research. The need to develop strategic plans was examined for research implications of three different scenarios: (1) low productivity and economic growth; (2) oil disruption; and (3) an optimistic future in which the U.S. restores its economic strength and leadership. DOE

N81-29580# Biphase Energy Systems, Inc., Santa Monica, Calif.
GENERATION OF USEFUL ENERGY FROM PROCESS FLUIDS USING THE BIPHASE TURBINE Final Report
N. L. Helgeson Jan. 1981 213 p refs
(Contract DE-AC07-76ET-15350)
(DOE/ET-15350/1) Avail: NTIS HC A11/MF A01

The six largest energy consuming industries in the United States were surveyed to determine the energy savings that could result from applying the Biphase turbine to industrial process streams. A national potential energy savings of 58 million barrels of oil per year (technical market) was identified. This energy is recoverable from flashing gas liquid process streams and is separate and distinct from exhaust gas waste heat recovery. The industries surveyed in this program were the petroleum chemical, primary metals, paper and pulp, stone-clay-glass, and food. It was required to determine the applicability of the Biphase turbine to flashing operations connected with process streams, to determine the energy changes associated with these flashes if carried out in a Biphase turbine, and to determine the suitability (technical and economical feasibility) of applying the Biphase turbine to these processes. DOE

N81-29588# Argonne National Lab., Ill.
HEAT-PUMP-CENTERED INTEGRATED COMMUNITY ENERGY SYSTEMS: SYSTEM DEVELOPMENT ASSESSMENT
J. M. Calm, G. R. Sapienza, and N. P. Biederman Mar. 1981 287 p refs
(Contract W-32-109-eng-38)
(ANL/CNSV-18) Avail: NTIS HC A13/MF A01

An assessment of district heating systems employing heat pumps to enable use of low-temperature energy sources is presented. These systems operate as thermal utilities to provide space heating and may also supply space cooling, service-water heating, and other thermal services. Natural sources including solar and geothermal heat, heat stored on an annual cycle from summer cooling, and otherwise-wasted heat from industrial and commercial processes may be effectively used by the systems described. Fifteen system analyses are examined. The assessment concludes that district heating with heat pumps can conserve energy resources, and particularly scarce fuels, in an environmental and economically attractive way. The application potential is believed to be broad, and the energy savings of widespread implementation would be substantial. No one system is universally applicable, but many system options exist. Market forces are already promoting many of the required technologies, but further research, development, and demonstration could accelerate implementation. DOE

N81-29593# Argonne National Lab., Ill. Energy and Environmental Systems Div.
COST COMPARISON OF THE SATELLITE POWER SYSTEM (SPS) AND SIX ALTERNATIVE TECHNOLOGIES
T. Wolsko and M. Samsa Apr. 1981 119 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-133) Avail: NTIS HC A06/MF A01

A method to compare the Satellite Power System (SPS) with various projected alternative energy sources on the basis of technical possibility, economic viability, and social and environmental acceptability is described. The following energy sources are briefly described: conventional coal, light water reactor, coal gasification/combined cycle, liquid metal fast breeder reactor, central station terrestrial photovoltaic, fusion, and the SPS. DOE

N81-29618# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
LAND-USE IMPLICATIONS OF WIND-ENERGY-CONVERSION SYSTEMS
R. J. Noun Feb. 1981 7 p Presented at the Conf. and Exposition-Wind Power: Energy Alternatives for the Upper Midwest, Rochester, Minn., 3-4 Apr. 1981; sponsored by Alternative Sources of Energy, Inc. and the Rochester Energy Information Center
(Contract EG-77-C-01-4042)
(SERI/TP-744-1099; CONF-810447-1) Avail: NTIS HC A02/MF A01

An estimated 20 utilities in the United States are now investigating potential wind machine sites in their areas. Identifying sites for wind machine clusters (wind farms) involves more than just finding a location with a suitable wind resource. Consideration must also be given to the proximity of sites to existing transmission lines, environmental impacts, aesthetics, and legal concerns as well as the availability of and alternative uses for the land. These issues have made it increasingly difficult for utilities to bring conventional power plants on-line quickly. Utilities are now required, however, to give careful consideration to specific legal, social, and environmental questions raised by the siting of wind energy conversion systems. DOE

N81-29620# Argonne National Lab., Ill.
OVERVIEW OF DEPARTMENT OF ENERGY PROGRAMS TO STIMULATE NEW INDUSTRIAL TECHNIQUES
A. R. Evans 1980 8 p refs Presented at 2nd Ann. Industrial Program Grantee Conf., Hot Springs, Ariz., 14 May 1980
(Contract W-31-109-eng-38)
(CONF-8005155-1) Avail: NTIS HC A02/MF A01

With the objectives of the U.S. DOE to provide for the orderly and adequate supply of fuels to the nation's industry and the efficient use of the fuels by industry, a review is presented of DOE programs related to these objectives. The objective of the programs is to accelerate the availability and adoption of existing and new industrial techniques for increased energy efficiency or fuel substitution. Also described are some of the ways in which academic researchers cooperate with industry and DOE in carrying out these programs. Several topics for further research are suggested. DOE

N81-29622# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
IMPACTS OF THE RESIDENTIAL CONSERVATION SERVICE PROGRAM ON RESIDENTIAL SOLAR DEVELOPMENTS
Tom Potter and Tad L. Bircher Apr. 1981 6 p refs Presented at the AS/ISES Conf. and Exposition, Philadelphia, 26-30 May 1981
(Contract EG-77-C-01-4042)
(SERI/TP-722-1169; CONF-810509-16) Avail: NTIS HC A02/MF A01

The roles of the various participants in the Residential Conservation Service (RCS) program were examined, with special attention to their potential influence on the program's effectiveness in accelerating solar commercialization. Cooperation and support

of the participants will be necessary for the information and implementation assistance goals of the program to be achieved, but resistance and obstructions are noted. DOE

N81-29663# Energy Resources Co., Inc., Walnut Creek, Calif.
ENVIRONMENTAL ASPECTS OF ALTERNATIVE WET TECHNOLOGIES FOR PRODUCING ENERGY/FUEL FROM PEAT Final Report
R. T. Smith 1 May 1981 142 p refs
(Contract DE-PR18-80FC-10169)
(DOE/FC-10169/T1) Avail: NTIS HC A07/MF A01

Peat in situ contains up to 90 percent moisture, with about 90 percent of this moisture trapped as a colloidal gel. This colloidal moisture cannot be removed by conventional dewatering methods (filter presses, etc.) and must be removed by thermal drying, solvent extraction, or solar drying before the peat can be utilized as a fuel feedstock for direct combustion or gasification. To circumvent the drying problem, alternative technologies such as wet oxidation, wet carbonization, and biogasification are possible for producing energy or enhanced fuel from peat. These three alternative technologies are described and the material balances for given raw peat feed rates of 1000 tph were calculated and the environmental consequences of all process effluent discharges were evaluated. DOE

N81-29668# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
SUBMICRON PARTICULATES FROM PULVERIZED-COAL COMBUSTION
J. Pennucci, R. Greif, G. Parsons, F. Robben, and P. Sheman Mar. 1981 8 p refs Presented at the Western States Section/The Combust. Inst. Spring Meeting, Pullman, Wash., 13-14 Apr. 1981
(Contract W-7405-eng-48)
(LBL-12485; CONF-810466-2) Avail: NTIS HC A02/MF A01

The effect of heat transfer and combustion parameters on the number and size distribution of particles in the submicron range, including consideration of practical methods of their control was studied. The flame temperature, cooling rate and oxygen concentration in the fuel lean range are investigated. Peak temperatures varied from 1900 K to 2500 K. It is shown that there is competition between homogeneous and heterogeneous nucleation of vaporized material, in various models of pulverized coal fly ash formation. It is indicated that there are possibilities to control the smallest prticles by varying the cooling rates in the post flame region. DOE

N81-29670# Oak Ridge National Lab., Tenn. Energy Div.
ENVIRONMENTAL IMPLICATIONS OF SMALL FIXED-BED GASIFIERS FOR INDUSTRY
Jerome E. Dobson, Robert M. Cushman, Phillip J. Walsh, Garland A. Samuels, David P. Vogt, John B. Mills, Suman P. Singh, Peter A. Dauzvardis (Argonne National Lab.), Charles M. Macal (Argonne National Lab.), and Roger L. Kroodsma May 1981 167 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7361) Avail: NTIS HC A08/MF A01

The assessment focuses on the industrial utilization of low energy gas (often called low Btu gas) in the range of 3708 to 7416 kJ/cu cm manufactured on site or nearby in a coal air steam reaction process. The major risk is in occupational health due to potential exposure to toxic substances. This risk to workers is considerably greater than the risk to the public at large. The major sources of occupational exposure will be process steam leaks, accidental spills, and maintenance operations. DOE

N81-29673# Mitre Corp., McLean, Va.
HEALTH AND ENVIRONMENTAL EFFECTS OF SYNTHETIC FUEL TECHNOLOGIES: RESEARCH PRIORITIES. REPORT TO THE FEDERAL INTERAGENCY COMMITTEE ON THE HEALTH AND ENVIRONMENTAL EFFECTS OF ENERGY TECHNOLOGIES
R. D. Brown Apr. 1981 229 p
(Contract DE-AC01-79EV-10018)
(MTR-80W348) Avail: NTIS HC A11/MF A01

An assessment of the health and environmental effects of research priorities related to coal gasification and liquefaction and oil shale development is presented. It reflects the subjective judgments of well chosen research scientists in relevant disciplines. These scientists reviewed the resuls of workshops conducted in 1978 on coal gasification and liquefaction and oil shale, background information on related federal research, and comments by relevant federal agencies. The scientists prepared a listing of current research needs according to major areas of concern. These were categorized as to generic, region specific, or process specific research. For the latter category, various scales of development were addressed for two exemplary processes: SRC (solvent refined coal) II and above ground oil shale retorting. Subjective judgments were used to prioritize the research tasks and assess the adequacy of current research. DOE

N81-29677# California Univ., Livermore. Lawrence Livermore Lab.
ENVIRONMENTAL IMPACTS OF THE PRODUCTION AND UTILIZATION OF CARBONACEOUS FUELS: A BRIEF OVERVIEW
D. H. Stuermer and M. A. Tompkins 1980 10 p refs Presented at DOE Workshop on Basic Res. in Organic Geochem. Appl. to Natl. Energy Needs, St. Petersburg, Fla., 15 Dec. 1980 Sponsored by DOE
(UCRL-85599; CONF-801249-1) Avail: NTIS HC A02/MF A01

The projected increased future use of fossil fuels over the next several decades will intensify many of the current environmental concerns. These concerns include the following: contamination of water resources; consequences of various solid and liquid waste disposal alternatives; atmospheric input of organic emissions, SO sub x, NO sub x, particulates, smog forming products, and associated acid rain; increased global atmospheric CO2 concentrations; and, spills of crude and synthetic oils and their refined products. The development of oil shale, coal, tar sands, and enhanced oil recovery (EOR) resources will have regional impacts related to the distribution of the resources. DOE

N81-29687# Operations Research, Inc., Silver Spring, Md.
THE POTENTIAL FOR COAL USE AND RELATED ECONOMIC AND AIR QUALITY IMPLICATIONS OF FUTURE ENERGY SCENARIOS Final Report
Mar. 1981 325 p refs
(Contract NCAQ-24A-AQ-7744)
(PB81-179475; AQ-7744-24A) Avail: NTIS HC A14/MF A01 CSCL 13B

The air quality changes total costs associated with different national energy policies and related supply and demand scenarios were examined. The key issues examined are: the potential for coal use in the near and long-term under present air pollution control requirements and under related policy options; and the effect on air quality and total energy user costs as the energy supply mix of coal, oil, gas, nuclear, and solar is altered by air pollution policy options, energy demand forecasts, and energy production plans. GRA

N81-29691# TRW, Inc., Redondo Beach, Calif.
ENVIRONMENTAL ASPECTS OF SYNFUEL UTILIZATION Final Report, Mar. 1980 - Feb. 1981
M. Ghassemi and R. S. Lyer Mar. 1981 404 p refs
(Contract EPA-68-02-3174)
(PB81-175937; EPA-600/7-81-025) Avail: NTIS HC A18/MF A01 CSCL 13B

Environmental concerns about the distribution, handling, and end use of synfuel products are discussed. Available data on the physical, chemical, and health effects characteristics of synfuel products and the environmental significance of such characteristics are reviewed; the potential environmental impacts and regional implications associated with the production and end use are analyzed; and the products from the standpoint of environmental concerns and mitigation requirements are reported. Results indicate that: (1) widescale transportation, distribution, and end use of certain synfuel products present significant threats to the environment and the public health; (2) synfuel products appear to be similar to petroleum products; and (3) synfuel test and evaluation programs provide opportunities for the collection of some of the required environmental data. GRA

N81-29701# Edaw, Inc., Palo Alto, Calif.
PROBLEM DEFINITION STUDY OF SUBSIDENCE CAUSED BY GEOPRESSURED GEOTHERMAL RESOURCE DEVELOPMENT Rept., 1 Oct. 1979 - 30 Sep. 1980
Dec. 1980 186 p refs Prepared in cooperation with Earth

Sciences Associates, Palo Alto, Calif.
(Contract W-7405-eng-48)
(LBL-12392; GSRMP-10) Avail: NTIS HC A09/MF A01

The environmental and socio-economic settings of four environmentally representative Gulf Coast geopressured geothermal fairways were inventoried. Subsidence predictions were prepared using feasible development scenarios for the four representative subsidence sites. Based on the results of the subsidence estimates, an assessment of the associated potential environmental and socioeconomic impacts was prepared. An inventory of mitigation measures was also compiled. Results of the subsidence estimates and impact assessments are presented, as well as conclusions as to what are the major uncertainties, problems, and issues concerning the future study of geopressured geothermal subsidence. DOE

N81-29777# Environmental Protection Agency, Cincinnati, Ohio. Health Effects Research Lab.
HEALTH EFFECTS OF DIESEL ENGINE EMISSIONS: PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM HELD AT CINCINNATI, OHIO ON DECEMBER 3-5, 1979, VOLUME 1
W. E. Pepelko, ed., R. M. Danner, ed., and N. A. Clarke, ed. Nov. 1980 591 p refs Proceedings of Conf. held in Cincinnati, Ohio, 3-5 Dec. 1979 2 Vol.
(PB81-173809; EPA-600/9-80-057A) Avail: NTIS HC A25/MF A01 CSCL 06T

The purpose of this Symposium was to bring together scientists and engineers from the public and private sectors to discuss their research findings on the health effects of diesel engine emissions and to conclude with a discussion of health risk assessment of diesel exhaust. The Proceedings are organized into eight main sections corresponding to the format of the Symposium and addressing physical and chemical characteristics of diesel effects of diesel emissions and components, and biochemical and metabolic effects GRA

N81-29778# Environmental Protection Agency, Cincinnati, Ohio. Health Effects Research Lab.
HEALTH EFFECTS OF DIESEL ENGINE EMISSIONS: PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM
W. E. Pepelko, ed., R. M. Danner, ed., and N. A. Clarke, ed. Nov. 1980 632 p refs Proceedings of Conf. held in Cincinnati, Ohio, 3-5 Dec. 1979 2 Vol.
(PB81-173817; EPA-600/9-80-057B) Avail: NTIS HC A99/MF A01 CSCL 06T

The Proceedings are organized into sections corresponding to the format of the Symposium and addressing toxicological effects of inhaled diesel emissions, mutagenic and carcinogenic potency of extracts of diesel and related environmental emissions, mutagenicity of inhaled diesel emissions, carcinogenic effects of exposure to diesel emissions, and epidemiological studies. A panel discussion on health risk assessment of diesel emissions is included. GRA

N81-30046# Battelle Pacific Northwest Labs., Richland, Wash.
ANALYSIS OF FEDERAL INCENTIVES USED TO STIMULATE ENERGY CONSUMPTION
R. J. Cole, B. W. Cone, J. C. Emery, M. Huelshoff, D. E. Lenarz, A. Marcus, F. A. Morris, W. J. Sheppard, and P. Sommers Apr. 1981 14 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3558-EX-Summ) Avail: NTIS HC A02/MF A01

Data on estimated cost of incentives used to stimulate energy consumption by incentive type and energy source are tabulated for coal, oil, gas, and electricity. It is suggested that the examination of past incentives can be useful in developing guidelines and limits for the use of incentives to stimulate consumption of solar energy. DOE

N81-30060# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY-STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 1: OVERVIEW AND FINDINGS Final Report
L. G. OConnell, C. J. Anderson, E. Behrin, W. Cliff (Battelle Pacific Northwest Lab., Seattle, Wash.), R. Crisp (Arkansas Univ. Fayetteville), H. C. Forsberg, C. L. Hudson (Interplan Corp.), J. S Payne, R. Renner, M. D. Schrot et al 15 Dec. 1980 67 p refs 4 Vol.
.Contract W-7405-eng-48)
(UCRL-53053-80-Vol-1) Avail: NTIS HC A04/MF A01

Results of a national multilaboratory study of energy storage propulsion systems for automobiles are presented. The findings of the five participating panels are given, including a technical and cost analysis for the energy storage devices and resulting vehicles, as well as a discussion of national impact issues. Information on electrochemical, mechanical, chemical, and thermal energy storage devices is presented. The feasibility of developing each type of system for use in automobiles; the effects of such usage on vehicle design, safety, performance, cost, and marketability; and the impact on US petroleum consumption of the commercialization of vehicles with energy storage equipment are addressed. DOE

N81-30063# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY-STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 4: NATIONAL IMPACT ISSUES Final Report
L. G. OConnell, C. J. Anderson, E. Behrin, W. Cliff (Battelle Pacific Notthwest Labs., Wash.), R. Crisp (Arkansas Univ., Fayetteville), H. C. Forsberg, C. L. Hudson (Interplane Corp.), J. S. Payne, R. Renner, M. D. Schrot et al 15 Dec. 1980 255 p refs 4 Vol.
(Contract W-7405-eng-48)
(UCRL-53053-80-Vol-4) Avail: NTIS HC A12/MF A01

Information on the social, economic, environmental, health, and energy impacts predicted as the result of marketing advanced automobiles with energy storage systems, are presented. The effects of manufacturing and service infrastructure for ESV's, and specialty markets for ESV's are addressed. DOE

N81-30222# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
COAL CONVERSION SOLID WASTES: CHARACTERIZATION FOR ENVIRONMENTAL ASSESSMENT
S. Y. Lee and W. J. Boegly, Jr. Jun. 1981 43 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7533) Avail: NTIS HC A03/MF A01

Physicochemical and leaching properties of coal conversion solid wastes produced by British Gas-Lurgi, Cogas, and Texaco gasification pilot plants were measured in order to assess the potential environmental impact caused by disposal of these wastes. The British Gas-Lurgi waste was composed of homogeneous calcic aluminosilicate glass with less than 1 percent of metallic iron particles. Major and trace elements were diluted by the influx of limestone added during the slagging process. The Cogas waste was partially vitrified ferruginous aluminosilicate with a surface occasionally covered by iron oxide coatings. Immiscible iron oxide and iron sulfide phases in the aluminosilicate matrix of ferromagnetic particles were detected. The Texaco gasification waste was composed of sulfur rich ferruginous aluminosilicate particles, and the surface of the particles was extensively coated by amorphous iron sulfide and occasionally by lepidocrocite. Pyrrhotite mineral was dominant in the ferromagnetic fraction. DOE

N81-30228# Battelle Pacific Northwest Labs., Richland, Wash.
CHEMICAL PRODUCTION FROM INDUSTRIAL BY-PRODUCT GASES Final Report
S. E. Lyke and R. H. Moore Apr. 1981 128 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3753) Avail: NTIS HC A07/MF A01

The potential for conservation of natural gas is studied and the technical and economic feasibility and the implementation of ventures to produce such chemicals using carbon monoxide and hydrogen from byproduct gases are determined. A survey was performed of potential chemical products and byproduct gas sources. By-product gases from the elemental phosphorus and the iron and steel industries were selected for detailed study. Gas sampling, preliminary design, market surveys, and economic analyses were performed for specific sources in the selected industries. The study showed that production of methanol or ammonia from byproduct gas at the sites studied in the elemental phoephorus and the iron and steel industries is technically feasible but not economically viable under current conditions. Several other applications are identified as having the potential for better economics. DOE

N81-30278# Falcon Research and Development Co., Buffalo, N. Y.

EVALUATION OF STATISTICAL PROCEDURES FOR GRADING FUEL EFFICIENT ENGINE OILS Final Report
S. Kaufman, H. T. McAdams, and N. Morse Nov. 1980 78 p refs
(Contract EPA-68-03-2835)
(PB81-188930; EPA-460/3-81-012; Rept-3520-2/BUF-40) Avail: NTIS HC A05/MF A01 CSCL 11H

In March 1980 the EPA distributed for industry comment at draft 'EPA Recommended Practice for Evaluating, Grading, and Labeling the Fuel Efficiency of Motor Vehicle Engine Oils'. The EPA request Falcon Research and and Development Co. to 'analyze comments received...with regard to the recommended statistical procedure'. As a follow up effort, Falcon was requested to provide an independent assessment of certain aspects of the proposed statistical procedure. Particular areas identified for consideration were: (1) comparative accuracy of carryover and non-carryover effect procedures; (2) means for encouraging (rewarding) accurate testing; (3) dealing with outliers in fuel economy test data; and (4) the impact of variability in oil effects across car models on the meaningful grading of oils. An investigation of these areas, and cursory examination of some additional topics form the subject of this report. GRA

N81-30313# Oak Ridge National Lab., Tenn.
A MATRIX APPROACH TO BIOLOGICAL INVESTIGATION OF SYNTHETIC FUELS
David L. Coffin Mar. 1981 79 p refs Conf. held at Research Triangle Park, N.C., 26 Apr. 1979; sponsored by EPA and DOE (PB81-183477; EPA-600/9-81-009) Avail: NTIS HC A05/MF A01 CSCL 06T

Documentation is provided for a conference on toxicological assessment of health effects from the rapidly developing synthetic fuels industry. The discussions focus on the Paraho crude shale oil produced and refined into diesel and jet fuels. Summaries of both operations are presented. Also discussed is the collection, storage, and distribution to toxicologists of sample materials from these operations. GRA

N81-30319# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
AIR INFILTRATION IN BUILDINGS Ph.D. Thesis
Max Howard Sherman Oct. 1980 125 p refs
(Contract W-7405-eng-48)
(LBL-10712) Avail: NTIS HC A06/MF A01

A physical model of infiltration in buildings that can be used to predict the infiltration for a wide range of construction types and climate regions is presented. The problems associated with commonly used tracer gas methods for measuring infiltration were examined in detail so that results obtained from the model could be properly compared with actual measurements. In addition, a simple model of the hydrodynamics of typical leaks in the building envelope was devised in order to study the physical processes of infiltration (i.e., the flow of air through cracks in the structure of the building). Finally, a method for quantifying the leakage of the building envelope (the quantity analogous to envelope thermal conductance) was developed. The name given to this measurement technique is AC pressurization. Although other methods exist for measuring the leakage of a building envelope, AC pressurization is far more accurate and can be used at lower pressures than any existing methods. The model, based on the determination of the effective leakage area, was used to predict the infiltration at 15 separate sites. DOE

N81-30394# Midwest Research Inst., Golden, Colo. Building Systems Development Branch.
ANALYSIS OF THE PERFORMANCE AND SPACE-CONDITIONING IMPACTS OF DEDICATED HEAT-PUMP WATER HEATERS
L. Morrison and J. Swisher Dec. 1980 15 p refs Presented at 3rd Ann. Systems Simulation Econ. Analysis/Solar Heating and Cooling Operational Results Conf., Reno, Nev., 27 Apr. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-721-1014; CONF-810405-15) Avail: NTIS HC A02/MF A01

The operation of a newly marketed dedicated heat pump water heater (HPWH) which utilizes an air to water heat pump, costs about $1000 installed, and obtains a coefficient of performance (COP) of about 2.0 in laboratory and field tests, is a space conditioning benefit if an air conditioning load exists and a penalty if a space heating load exists. A simulation was developed to model the thermal performance of a residence with resistance baseboard heat, air conditioning, and either heat pump or resistance water heating. The building characteristics were adapted (Madison, Wisconsin; Washington, DC; and Ft. Worth, Texas) and the system was simulated for a year with typical weather data. For each city, HPWH COPs are calculated monthly and yearly. The water heating and space conditioning energy requirements of HPWH operation are compared with those of resistance water heater operation to determine the relative performance ratio of the HPWH DOE

N81-30512 International Institute for Applied Systems Analysis, Laxenburg (Austria).
THE IIASA SET OF ENERGY MODELS: ITS DESIGN AND APPLICATION
Paul S. Basile, M. Agnew, A. Holzl, Yu. Kononov, A. Papin, H.-H. Rogner, and L. Schrattenholzer Dec. 1980 67 p refs (IIASA-RR-80-31) Avail: Issuing Activity

The models studied include an accounting framework type energy demand model, a dynamic linear programming -energy supply and conversion system model, an input-output model, a macroeconomic model, and an oil trade gaming model. They are incorporated in an integrated set for long-term, global analyses. This set makes use of a highly iterative process for energy scenario projections and analyses. Each model is quite simple and straightforward in structure; a great deal of human judgement is necessary in applying the set. The models are applied to study two alternative energy scenarios for a coming fifty year period. Examples are presented revealing the wealth of information that can be obtained from multimodel techniques. Details are given for several models (equations employed, assumptions made, data used). Author (ESA)

N81-30524*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SYSGEN USER PACKAGE
C. R. Carlson 15 Mar. 1981 119 p refs
(Contracts NAS7-100; DE-AT04-81AL-16228)
(NASA-CR-164706; JPL-Pub-81-47; DOE/JPL-1060-47) Avail: NTIS HC A06/MF A01 CSCL 10B

The user documentation of the SYSGEN model and its links with other simulations is described. The SYSGEN is a production costing and reliability model of electric utility systems. Hydroelectric, storage, and time dependant generating units are modeled in addition to conventional generating plants. Input variables, modeling options, output variables, and reports formats are explained. SYSGEN also can be run interactively by using a program called FEPS (Front End Program for SYSGEN). A format for SYSGEN input variables which is designed for use with FEPS is presented. E.A.K.

N81-30551*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MARKET ASSESSMENT OVERVIEW
Hamid Habib-agahi *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 241-246 (For primary document see N81-30525 21-44)
Avail: NTIS HC A13/MF A01 CSCL 05C

Market assessment, refined with analysis disaggregated from a national level to the regional level and to specific market applications, resulted in more accurate and detailed market estimates. The development of an integrated set of computer simulations, coupled with refined market data, allowed progress in the ability to evaluate the worth of solar thermal parabolic dish systems. In-depth analyses of both electric and thermal market applications of these systems are described. The following market assessment studies were undertaken: (1) regional analysis of the near term market for parabolic dish systems; (2) potential early market estimate for electric applications; (3) potential early market estimate for industrial process heat/cogeneration applications; and (4) selection of thermal and electric application case studies for fiscal year 1981. S.F.

N81-30559*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REGIONAL CHARACTERISTICS RELEVANT TO ADVANCED TECHNOLOGY COGENERATION DEVELOPMENT
Ram Manvi Jul. 1981 155 p refs Sponsored in part by DOE
(Contract NAS7-100)

(NASA-CR-164697; JPL-Pub-81-61) Avail: NTIS HC A08/MF A01 CSCL 10B

To assist DOE in establishing research and development funding priorities in the area of advanced energy conversion technology, researchers at the Jet Propulsion Laboratory studied those specific factors within various regions of the country that may influence cogeneration with advanced energy conversion systems. Regional characteristics of advanced technology cogeneration possibilities are discussed, with primary emphasis given to coal derived fuels. Factors considered for the study were regional industry concentration, purchased fuel and electricity prices, environmental constraints, and other data of interest to industrial cogeneration. A.R.H.

N81-30660*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CONCEPTS FOR DESIGN OF AN ENERGY MANAGEMENT SYSTEM INCORPORATING DISPERSED STORAGE AND GENERATION

H. Kirkham, T. Koerner, and D. Nightingale 15 Apr. 1981 135 p refs

(Contracts NAS7-100; Contract DE-AI01-79ET-29372)

(NASA-CR-164700; JPL-Pub-81-20; DOE/ET-29372/1) Avail: NTIS HC A07/MF A01 CSCL 10B

New forms of generation based on renewable resources must be managed as part of existing power systems in order to be utilized with maximum effectiveness. Many of these generators are by their very nature dispersed or small, so that they will be connected to the distribution part of the power system. This situation poses new questions of control and protection, and the intermittent nature of some of the energy sources poses problems of scheduling and dispatch. Under the assumption that the general objectives of energy management will remain unchanged, the impact of dispersed storage and generation on some of the specific functions of power system control and its hardware are discussed. A.R.H.

N81-30582# Hawaii Community Design Center, Honolulu

HOME ENERGY SAVER'S HANDBOOK Final Report

Noreen N. Koga, ed. Sep. 1980 43 p refs

(Contracts DE-FG03-78SF-01910; EM-78-G-03-1910)

(DOE/SF-01910/T1) Avail: NTIS HC A03/MF A01

Energy is described and how much energy a household consumes is discussed. The saving of energy is recommended and measures to save energy when operating hot water heaters, air conditioners, lighting systems refrigerators, freezers, stoves, microwave ovens, washing machines, clothes dryers, dishwashers, television sets, and portable appliances are summarized. DOE

N81-30585# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.

REGIONAL ANALYSIS OF ENERGY FACILITY SITING

F. W. Lipfert, P. M. Meier, and L. I. Kleinman 1980 37 p refs Presented at the SOGESTA Workshop on Energy Policy Analysis, Urbino, Italy, 3-6 Nov. 1980

(Contract DE-AC02-76CH-00016)

(BNL-29324; CONF-801137-5) Avail: NTIS HC A03/MF A01

Some of the regional environmental parameters of energy facility siting with emphasis on air quality impacts were examined. An example of a siting optimization study is presented, and it is shown how difficult it presently is to specify an environmental objective function that is universally applicable. The importance of regional background effects are discussed, and long range transport models are used to analyze the relative importance of local and long range impacts. DOE

N81-30619# Oak Ridge National Lab., Tenn. Energy Div.

LINK BETWEEN TRADITIONAL PLANNING AND ENERGY MANAGEMENT

M. Schweizer 1981 13 p refs Presented at the Community Energy Planning Conf., Gatlinburg, Tenn., 21-20 Jan. 1981; sponsored by the Tennessee Chapter of the American Planning Association and Tennessee Univ.

(Contract W-7405-eng-26)

(CONF-810140-1) Avail: NTIS HC A02/MF A01

Community energy planning is the process of envisioning a desired future state of energy supply and consumption for a local area and designing the appropriate measures to implement that future. While energy planning can be distinguished from other specialized concerns, such as housing or transportation planning, there are also major similarities which bind all these elements together. These similarities and differences are discussed. Community level energy planning represents a natural extension of the comprehensive planning process. As the comprehensive plan has grown in the past to reflect new subjects of public concern such as environmental quality and economic development, so it can evolve further to address society's growing interest in energy use. DOE

N81-30620# Oak Ridge National Lab., Tenn. Energy Div.

APPROPRIATE ENERGY TECHNOLOGY FOR URBAN AREAS

W. R. Mixon 1981 9 p refs Presented at Workshop on Status of Res. and Methods of Evaluation Interaction, Gainesville, Fla., 14-16 May 1981

(Contract W-7405-eng-26)

(CONF-810565-1) Avail: NTIS HC A02/MF A01

Some of the unique characteristics of high density urban areas as they affect the potential use of energy conservation measures and more efficient and renewable energy sources are addressed. Energy related problems of urban areas are presented and the inner city is characterized as an environment with limited potential for applying conservation measures and innovative energy sources of the level of individual buildings. District heating and cooling is presented as one technology, uniquely appropriate for urban areas, that can collect thermal energy from efficient cogeneration plants, municipal incinerators, industrial processes, and renewable natural energy resources and distribute that energy throughout a community to its ultimate consumers. Through district heating, the urban communities can conserve energy and scarce fuels, improve environmental quality, and participate in achieving a more harmonious interface between humanity and the natural environment. DOE

N81-30630# Department of Energy, Washington, D. C. Office of Industrial Programs.

INDUSTRIAL ENERGY-EFFICIENCY IMPROVEMENT PROGRAM Annual Report to the Congress and the President, 1979

1 Dec. 1980 83 p

(DOE/CE-0001) Avail: NTIS HC A05/MF A01

The industrial energy efficiency improvement program to accelerate market penetration of new and emerging industrial technologies is described. Practices which will improve energy efficiency, encourage substitution of more plentiful domestic fuels, and enhance recovery of energy and materials from industrial waste streams are enumerated. Specific reports from the chemicals and allied products; primary metals; petroleum and coal products; stone, clay, and glass, paper and allied products; food and kindred products; fabricated metals; transportation equipment; machinery (except electrical); textile mill products; rubber and miscellaneous plastics; electrical and electronic equipment; lumber and wood; and tobacco products are discussed. A summary on progress in the utilization of recovered materials, and an analysis of industrial fuel mix is presented. DOE

N81-30631# Los Alamos Scientific Lab., N. Mex.

CHARACTERIZATION OF HOT DRY ROCK GEOTHERMAL ENERGY EXTRACTION SYSTEMS

James N. Albright and Carl A. Newton 1981 7 p refs Presented at the SQUID Applications to Geophys. Workshop, Los Alamos, N. Mex., 2-4 Jun. 1980

(Contract W-7405-eng-36)

(LA-UR-81-1620; CONF-810660-1) Avail: NTIS HC A02/MF A01

The engineering of heat exchange systems by which geothermal heat can be efficiently extracted from hot impermeable rocks is studied. The system currently under investigation at Fenton Hill, New Mexico consists of a network of large fractures created through the hydraulic pressurization of a well penetrating hot basement rocks and subsequently intersected by a second well drilled to form a flow-thru system. Cool water pumped into the fractures through one well, once heated in the reservoir, returns to the surface through the second well, is cooled, and then recirculated. While much is known about the performance parameters of the fracture network from short-term flow tests, little is understood concerning the spatial dimensions and geometrical relationship of individual fractures comprising the network. Ultimately, the success one has in estimating the long-term performance of such a system where commercialization

is an issue, and in engineering future systems with optimal performance, depends on the success in characterizing the flow-thru fracture networks. DOE

N81-30637# Oak Ridge National Lab., Tenn. Energy Div.
COMMUNITY-BASED ASSESSMENT AND PLANNING OF ENERGY FUTURES
Sam A. Carnes 1981 17 p refs Presented at the Community Energy Planning Conf., Gatlinburg, Tenn., 29-30 Jan. 1981; sponsored by the Tennessee Chapter of the American Planning Association and Tennessee Univ.
(Contract W-7405-eng-26)
(CONF-810140-2) Avail: NTIS HC A02/MF A01

The decentralized solar energy technology assessment program is discussed. Four communities were involved in an assessment of the compatibility of diverse conservation and renewable energy supply technologies and community values and goals and in community planning for the implementation of compatible energy demand and supply alternatives. The community approach has several basic components: (1) recruiting and organizing for the assessment planning process; (2) collection and analysis of data related to community energy use and indigenous renewable energy resources; (3) creation and maintenance of a community education and information program; (4) development of policies favorable to the development of preferred community futures; and (5) development of implementation or action strategies. The role of public participation, group decision making techniques, the role of technical information in citizen and group decision making, and linkage between assessment planning and the relevant policy process are emphasized. DOE

N81-30638# Battelle Columbus Labs., Ohio.
TECHNOLOGY FOR THE DEVELOPMENT OF HIGH EFFICIENCY OIL-FIRED RESIDENTIAL HEATING EQUIPMENT Final Report
D. W. Locklin and H. R. Hazard Jun. 1980 264 p refs B0066127 Prepared for Brookhaven National Lab., Upton, N.Y.
(Contract DE-AC02-76CH-00016)
(BNL-51325) Avail: NTIS HC A12/MF A01

The development of efficient residential oil burning equipment with capability for reliable, low capacity operation is assessed. Technical approaches with potential application to unconventional types of oil burners and to efficient heat exchangers, including those that operate partially in the mode of condensing moisture from the flue gases to regain the latent heat of vaporization are reviewed. The following concepts are recommended for further investigation in the development of efficient oil fired heating equipment: (1) modified high pressure atomizing systems; (2) alternative methods of atomization; (3) blue flame burners; (4) pulse combustion systems; and (5) condensing-type heat exchangers. DOE

N81-30639# Department of Energy, Washington, D. C. Office of Consumption Data System.
RESIDENTIAL ENERGY-CONSUMPTION SURVEY: CONSUMPTION AND EXPENDITURES, PART 1: NATIONAL DATA INCLUDING CONSERVATION
Apr. 1981 160 p refs
(DOE/EIA-0262/1) Avail: NTIS HC A08/MF A01

The results of the second residential energy consumption survey are presented. Data on consumption and expenditures are presented for the year April 1979 through March 1980. Tables are also presented which indicate the cost and incidence of major insulation added to US households in 1978 and 1979. The tables are from the final data file that contains imputations for missing data and includes information from the mail questionnaires. The report contains selected tabulations for each of the four Census regions for the period 1978-1980. Included are: a summary of findings showing comparisons in residential energy consumption between the 1978 to 1979 and 1979 to 1980 time periods a description of how the survey was conducted, a statement about the limitations of the data including relative standard errors, a copy of the survey forms, and a glossary.DOE

N81-30640# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ECONOMIC ANALYSIS OF INDUSTRIAL WASTE-HEAT RECOVERY: FLUIDIZED-BED TECHNOLOGY VERSUS THREE CONVENTIONAL ALTERNATIVES
Paul J. Grogan, Harry L. Brown, Michael J. Koluch, and Bernard B. Hamel Apr. 1981 40 p refs
(Contract W-31-103-eng-38)
(ANL/CNSV/TM-68) Avail: NTIS HC A03/MF A01

The performance parameters and costs of these technologies were based upon existing information. Data on available waste energy in industry, and the temperatures and operating sources of that energy were based upon the Industrial Plant Energy Profile (IPEP). This data base contains plant-energy information from approximately 400,000 industrial plant sites in the country. These sites represent the bulk of the nation's industrial manufacturing capacity. Based on this information, the available waste energy from each of the industrial sectors was determined by process-unit operation. Waste energy was determined as a function of plant size. Each of the competing heat-recovery technologies, both conventional and fluidized-bed, was applied to the waste streams. Energy savings and payback were determined on the bases of waste-heat source and plant size. Conventional heat exchangers showed a significant number of applications with paybacks of less than one year. DOE

N81-30642# California Univ., Livermore. Lawrence Livermore Lab.
CANADA'S NEW NATIONAL ENERGY PROGRAM ON OIL AND GAS: WHAT ARE THE MAIN PROVISIONS? WHAT ARE THE REACTIONS SO FAR?
K. K. Burr Apr. 1981 73 p refs
(Contract W-7405-eng-48)
(UCID-19052) Avail: NTIS HC A04/MF A01

The Canadian federal government announced a National Energy Program (NEP) for oil and natural gas to achieve energy self sufficiency. The program deals with two major political and economic influences in Canadian energy: provincial ownership of natural resources and 70% of foreign ownership in the Canadian petroleum industry. The objectives to achieve national energy security, create opportunities for Canadian participation, and share resource benefits among the provinces. The major provisions include: a 80% federal tax on oil and gas production; a natural gas federal excise tax; a pricing scheme which holds conventional oil prices down but gives incentives for oil sands, heavy oil, and tertiary recovery production; a gas pricing scheme which encourages substitution of gas for oil; a 25% carried interest for the government on federal leases; and a Canadianization incentives grant system which replace the depletion allowance system. DOE

N81-30648# Research Inst. of National Defence, Stockholm (Sweden).
FACTOR DEMAND IN SWEDISH MANUFACTURING INDUSTRY WITH SPECIAL REFERENCE TO THE DEMAND FOR ENERGY. INSTANTANEOUS ADJUSTMENT MODELS; SOME RESULTS
Kent Rune Sjoeholm Feb. 1981 141 p refs
(FOA-C-10175-M5) Avail: NTIS HC A07/MF A01

The dual approach to the theory of production is used to estimate factor demand functions of the Swedish manufacturing industry. Two approximations of the cost function, the translog and the generalized Leontief models, are used. The price elasticities of the factor demand do not seem to depend on the choice of model. This is at least true as to the sign pattern and as to the inputs capital, labor, total energy and other materials. Total energy is separated into solid fuels, gasoline, fuel oil, electricity and a residual. Fuel oil and electricity are found to be substitutes by both models. Capital and energy are shown to be substitutes. This implies that Swedish industry will save more energy if the capital cost can be reduced. Both models are, in the best versions, able to detect an inappropriate variable. The assumption of perfect competition on the product market, is shown to be inadequate by both models. When this assumption is relaxed, the normal substitution pattern among the inputs is resumed. Author (ESA)

N81-30651# Rhode Island Univ., Kingston.
WATER, ENERGY, AND ECONOMIC DEVELOPMENT TOWARDS AN INTEGRATED REGIONAL POLICY ANALYSIS SYSTEM
Rudolph W. Hardy Feb. 1981 63 p refs Sponsored by Dept. of Interior
(PB81-184111; W81-02430; OWRT-C-90071; G/C-00191; G(9412)(1)) Avail: NTIS HC A04/MF A01 CSCL 10A

An integrated methodological approach in the economic development of water resources and preservation and energy

production and consumption was examined. The implications are explored, and potential solutions are sought. It is concluded that the nature of institutions and how they function require highly compartmentalized decision making/planning, and incentives for coordination appear weak. GRA

N81-30654# Pratt Inst., Brooklyn, N. Y.
ENERGY CONSERVATION POTENTIAL IN LOW-RISE, HIGH-DENSITY HOUSING Final Report, Sep. 1979 - Sep. 1980
Ron DiDonno New York New York State Energy Research and Development Authority Sep. 1980 221 p Sponsored by New York State Energy Research and Development Authority (PB81-104664; NYSERDA-80-9) Avail: NTIS HC A10/MF A01 CSCL 13A

Results of a year-long study of energy consumption in New York Housing Authority projects and of the design analysis for row house type buildings are reported. Computer simulations and economic analyses were made of 113 design options, and the most cost effective and energy efficient options were selected. GRA

N81-30661# Argonne National Lab., Ill. Energy and Environmental Systems Div.
IN PURSUIT OF CLEAN AIR: A DATA BOOK OF PROBLEMS AND STRATEGIES AT THE STATE LEVEL, SUPPLEMENT
D. B. Garvey, S. B. Moser, and D. G. Streets Aug. 1980 288 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-129) Avail: NTIS HC A13/MF A01

The Clean Air Act Amendments of 1977 and EPA regulations set stringent requirements for the control of emissions in areas where the National Ambient Air Quality Standards were exceeded. A previous five volume summary of nonattainment area designations and attainment strategies of the states as of July 1, 1980 is updated. Maps of PSD Class 1 areas and additional information on coal production, coal reserves, and coal quality are also included. DOE

N81-30666# Argonne National Lab., Ill.
ENVIRONMENTAL EFFECTS OF SPACE SYSTEMS
D. M. Rote 1980 13 p refs Presented at the AIAA Intern. Meeting and Tech. Display Global Technol. 2000, Baltimore, 6-8 May 1980
(Contract W-31-109-eng-38)
(CONF-800590-2) Avail: NTIS HC A02/MF A01

The potential effects of large space systems, primarily the Satellite Power System (SPS), on the upper atmosphere, were reviewed. From 56 to 500 km, the major contaminant sources are SPS microwave transmissions and rocket effluents. Deposition of rocket effluens causes compositional changes, most of which appear to be associated with the release of large amounts of water. The formation of ionospheric holes is an example of a modification resulting from the injection of propellant exhaust in the F-region. From 500 to 36,000 km, rocket effluents and ion engine contaminants could alter magnetospheric and plasmaspheric structure and dynamics. One of the major impacts of these alterations could be perturbation of Van Allen radiation belt stability, leading to changed radiation hazards to materials and personnal. DOE

N81-30668# Argonne National Lab., Ill. Energy and Environmental Systems Div.
TECHNOLOGY ASSESSMENT OF SOLAR ENERGY SYSTEMS: AIR-QUALITY EFFECTS OF DIRECT-SOLAR AND BIOMASS SYSTEMS IN HIGH AND LOW DEPLOYMENT SCENARIOS
L. Habegger, P. Dauzvardis, M. Snider, P. Michel, and W. Gasper Jan. 1981 85 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-140) Avail: NTIS HC A05/MF A01

The potential benefits and damages to air quality that are related to utilization of solar and biomass technologies as alternatives to more conventional energy producing technologies are evaluated. A compilation of emission levels from various biomass technologies is included. Secondly, it evaluates and compares national and regional cumulative emissions for two solar and biomass growth scenarios in the year 2000: a low growth scenario of 6 quad; and a high growth scenario of 14.2 quad. For the high growth solar scenario, both the national sulfur dioxide and nitrogen oxide emissions were projected to be approximately 5 percent lower than for the low growth scenario. In contrast, particulate emissions were estimated to be approximately 10 percent larger for the high growth scenario, primarily due to emissions from direct combustion of forest and agricultural residues in small, poorly controlled units. Both scenarios project an increase from 1975 national levels of sulfur dioxide and nitrogen dioxide emissions, and both project a decrease from 1975 national levels of particulate emissions. Air pollutant implications of the solar and biomass scenarios for the ten federal regions are also discussed. This indicates significant regional differences in technology mix and the relation of emission changes to attainment and maintenance of air quality standards within the regions. DOE

N81-30691# Mound Lab., Miamisburg, Ohio.
AIR QUALITY AND THE ENVIRONMENTAL EFFECTS FROM AN UNDERGROUND COAL-GASIFICATION TEST
P. W. Seabaugh, R. E. Zielinski, A. K. Agarwal, J. W. Martin (DOE, Morgantown, W. Va.), and A. J. Liberatore (DOE, Morgantown, W. Va.) 1981 9 p refs Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, San Francisco, 8 Jun. 1981
(Contract DE-AC04-76DP-00053)
(MLM-2837(OP); CONF-810607-4) Avail: NTIS HC A02/MF A01

Using fast response analytical systems and real-time data acquisition, a high density data base was acquired for 17 gaseous components of the product gas stream, including SO2, H2S, COS, and HCN. The data show that almost all gaseous sulfur from the bituminous coal was emitted as H2S. The SO2 and COS values rarely exceeded the background of the instruments although the COS values did rise to abut 100 ppM during the gasification phase. Except for one short period when values rose to 60 ppM, the HCN similarly stayed at the instrument background level of about 1 ppM. Because proven technology to clean H2S from gas streams is available, the test indicates that in-situ gasification of high sulfur bituminous coal on a commercial scale should not contribute to deterioration in air quality. DOE

N81-30692# Battelle Pacific Northwest Labs., Richland, Wash.
REVIEW OF PACIFIC NORTHWEST LABORATORY RESEARCH ON AQUATIC EFFECTS OF HYDROELECTRIC GENERATION AND ASSESSMENT OF RESEARCH NEEDS
D. H. Fickeisen, C. D. Becker, and D. A. Neitzel May 1981 32 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3816) Avail: NTIS HC A03/MF A01

The effect of hydroelectric generation on aquatic biota and environments is discussed. The research goals are to: (1) identify impacts of hydroelectric generation; (2) provide guidance in allocating scarce water resources; and (3) develop techniques to avoid or reduce the impacts on aquatic communities or to compensate for unavoidable impacts. The generic impacts of hydrogeneration is studied. The impacts studied result from a particular system of dams and operating procedures and occur within a specific ecosystem, however, the results have application at hydroelectric generating facilities throughout the United States. DOE

N81-30693# Argonne National Lab., Ill.
TRADEOFFS OF ENERGY CONSERVATION AND ENVIRONMENTAL QUALITY
Allen R. Evans 1980 6 p refs Presented at the 3rd World Energy Congr., Atlanta, 13-16 Oct. 1980
(Contract W-31-109-eng-38)
(CONF-801076-3) Avail: NTIS HC A02/MF A01

Studies performed on industrial energy conservation and pollution control are summarized. The primary purpose of the summary paper is to present the problem for the consideration of others, particularly those from industrial firms who must make the choices in selection of technologies. The paper is also presented as an appeal for more and better analyses of the energy costs of industrial pollution control equipment and new technologies related to energy efficiency improvement or fuel substitution. Industrial emissions and control costs, energy required for industrial pollution control, and effects of energy cost increase are discussed. DOE

N81-30702# Radian Corp., Austin, Tex.
SELECTIVE CATALYTIC REDUCTION AND NOx CONTROL IN JAPAN Final Report, Mar. 1980 - Jan. 1981

Gary D. Jones Mar. 1981 269 p
(Contract EPA-68-02-3171)
(PB81-191116; RAD-81-203-001-27-07; EPA-600/7-81-030)
Avail: NTIS HC A12/MF A01 CSCL 13B

Overall goals of the study were to obtain new information on curent issues concerning application of FGT technology and to update information previously published. A total of 28 equipment vendors, process operators, government agencies, and industry groups were contacted. Substantial recent progress was discovered with regard to commercial applications of selective catalytic reduction (SCR) technology to gas and oil fired boilers. There are several applications where SCR systems are operated continuously and are successfully removing 80% of the NOx from the flue gas stream. GRA

N81-30728# Argonne National Lab., Ill. Energy and Environmental Systems Div
TROPOSPHERIC EFFECTS OF SATELLITE POWER SYSTEMS
K. L. Brubaker and J. Lee 1980 10 p refs Presented at the AIAA Intern. Meeting and Tech. Display Global Technol. 2000, Baltimore, 6-8 May 1980
(Contract W-31-109-eng-38)
(CONF-800590-4) Avail: NTIS HC A02/MF A01

The construction and operation of a system of solar power satellites is expected to have a variety of effects on the troposphere. The launching of large space vehicles affects the air quality in the vicinity of the launch site, and the ground cloud associated with such a launch is known to stimulate the growth of water clouds under some circumstances. The transmission of power from satellite to the Earth's surface may affect certain meteorological parameters in the vicinity of the rectenna site. These and other effects are discussed in reference to the proposed solar power satellite system. DOE

N81-30763# National Oceanic and Atmospheric Administration, Boulder, Colo. Center for Environmental Assessment Services.
CLIMATIC DEGREE DAYS FOR ENERGY DEMAND ASSESSMENT
Henry E. Warren, Sharon K. LeDuc, and Mary S. Joshua Nov. 1980 146 p refs
(PB81-193880; NOAA-81021901) Avail: NTIS HC A07/MF A01 CSCL 04B

The development and procedures for the use of real time heating and cooling degree days information for States is presented. These State data are determined by population weighting heating and cooling degree days data from major National Weather Service stations. The concept of a degree day index is a result of the need to monitor temperature sensitive energy consumption on a disaggregated basis. Climatological normals and ranges of heating and cooling degree days are calculated for each State and presented in tabular and graphic form to facilitate the use of operational information. GRA

N81-30793# Environmental Protection Agency, Research Triangle Park, N.C. Health Effects Research Lab.
TUMORIGENESIS OF DIESEL EXHAUST, GASOLINE EXHAUST, AND RELATED EMISSION EXTRACTS ON SENCAR MOUSE SKIN
Stephen Nesnow, Larry L. Triplett (ORNL), and Thomas J. Slaga 1980 25 p refs Presented at the EPA 2nd Symp. on Application of Short Term Bioassays in the Analysis of Complex Environ Mixtures, Williamsburg Va., 4-7 Mar. 1980
(Contracts W-7405-eng-26; EPA-79-D-X0526; DOE-40-728-78)
(CONF-800323-4) Avail: NTIS HC A02/MF A01

The SENCAR mouse skin tumorigenisis bioassay for tumor initiation, a quantitative short term in vivo rodent carcinogenesis system which detects a variety of structurally diverse chemical carcinogens was examined. This bioassay system is utilized in evaluating complex environmental mixtures for tumorigenic potential. It provides dose responses with both substances and complex mixtures and is utilized for comparative potency analysis. The tumorigenicity of diesel exhaust particulate emissions was examined using SENCAR mouse skin. The tumorigenic potency of particulate emissions from diesel, gasoline, and related emission sources are compared and the tumorigenic potential of the materials is clearly indicated. E.A.K.

N81-30965# Argonne National Lab., Ill.
NORTHEAST REGIONAL ENVIRONMENTAL IMPACT STUDY: WASTE DISPOSAL TECHNICAL REPORT
J. L. S. Saguinsin Apr. 1981 243 p refs
(Contract W-31-109-eng-38)
(DOE/RG-0058) Avail: NTIS HC A11/MF A01

The potential for cumulative and interactive environmental impacts associated with the conversion of multiple generating stations in the Northeast is assessed. The estimated quantities and composition of wastes resulting from coal conversion, including ash and SO2 scrubber sludge, are presented. Regulations governing the use of ash and scrubber sludge are identified. Currently available waste disposal schemes are described. The location, capacity, and projected life of present and potential disposal sites in the region are identified. Waste disposal problems, both hazardous and nonhazardous, are evaluated. Environmental regulations within the region as they pertain to coal conversion and as they affect the choice of conversion alternatives are discussed. A regional waste management strategy for solid waste disposal is developed. DOE

N81-31016# Midwest Research Inst., Golden, Colo. Planning, Applications, and Impacts Div.
ORGANIZATIONAL PRECEDENTS FOR OWNERSHIP AND MANAGEMENT OF DECENTRALIZED RENEWABLE-ENERGY SYSTEMS
Richard Meunier and Jo Ann Silversmith Mar. 1981 62 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-744-312) Avail: NTIS HC A04/MF A01

Three existing organizational types that meet the decentralization criteria of local consumer ownership and control - cooperatives, Rural Electric Cooperatives, and municipal utilities - are examined. These three organizational precedents are analyzed in terms of their histories, structures, legal powers, sources of capital, and social and political aspects. Examples of related experiments with renewable energy technologies are given, and inferences are drawn regarding the organizations' suitability as vehicles for future implementation of decentralized renewable energy systems. DOE

N81-31025# Oak Ridge National Lab., Tenn. Engineering Physics Div.
INPUT PARAMETERS FOR LEAP AND ANALYSIS OF THE MODEL 22C DATA BASE
L. Stewart and Moshe Goldstein May 1981 226 p refs
(Contract W-7405-eng-26)
(ORNL-5746) Avail: NTIS HC A11/MF A01

The structure of the data base is briefly outlined and an attempt made to categorize the parameters according to the methods employed for estimating the numerical values. Due to incomplete documentation and/or lack of specific parameter definitions, few of the input values could be traced and uniquely interpreted using the information provided in the primary and secondary sources. Input parameter choices were noted which led to output projections which are somewhat suspect. Other data problems encountered are summarized. Some of the input data were corrected and a revised base case was constructed. The output projections for this revised case are compared with the Model 22C output for the year 2020, for the transportation sector. DOE

N81-31026# PEDCo-Environmental, Inc., Cincinnati, Ohio.
FLUE GAS DESULFURIZATION INFORMATION SYSTEM (FGDIS) DATA BASE USER'S MANUAL
M. Smith Mar. 1981 127 p Sponsored in part by EPA
(PB81-162505) Avail: NTIS HC A07/MF A01 CSCL 05B

A guide is provided for the use of the Flue Gas Desulfurization Information System (FGDIS) data base which is a collection of data files consisting of information pertaining to the design and performance of flue gas desulfurization (FGD) systems. GRA

N81-31032*# Mechanical Technology, Inc., Latham, N. Y. Engine Systems Div.
AUTOMOTIVE STIRLING REFERENCE ENGINE DESIGN REPORT
Jun. 1981 134 p
(Contracts DEN3-32; EC-77-A-31-10040)
(NASA-CR-165381; DOE/NASA/0032-12; MTI-81-ASE-164DR-2) Avail: NTIS HC A07/MF A01 CSCL 13F

The reference Stirling engine system is described which

provides the best possible fuel economy while meeting or exceeding all other program objectives. The system was designed to meet the requirements of a 1984 Pontiac Phoenix (X-body). This design utilizes all new technology that can reasonably be expected to be developed by 1984 and that is judged to provide significant improvement, relative to development risk and cost. Topics covered include: (1) external heat system; (2) hot engine system; (3) cold engine system; (4) engine drive system; (5) power control system and auxiliaries; (6) engine instalation; (7) optimization and vehicle simulation; (8) engine materials; and (9) production cost analysis. A.R.H.

N81-31038*# University of Southern California, Los Angeles. NASA Industrial Application Center.
ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 1: PROJECT SUMMARY AND PROCEDURES
D. H. Maund [1981] 54 p refs 4 Vol.
(Contract NAS2-10794)
(NASA-CR-166238-Vol-1; DRB-320-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 13B

The Advanced Technology Display House (ATDH) project is described. Tasks are defined in the areas of energy demand, water demand, sewage treatment, electric power, plumbing, lighting, heating, and air conditioning. Energy, water, and sewage systems are defined. S.F.

N81-31039*# University of Southern California, Los Angeles. NASA Industrial Application Center.
ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 2: ENERGY SYSTEM DESIGN CONCEPTS
D. H. Maund [1981] 62 p refs 4 Vol.
(Contract NAS2-10794)
(NASA-CR-166238-Vol-2; DRB-320-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 13B

The preliminary design concept for the energy systems in the Advanced Technology Display House is analyzed. Residential energy demand, energy conservation, and energy concepts are included. Photovoltaic arrays and REDOX (reduction oxidation) sizes are discussed. S.F.

N81-31040# Argonne National Lab., Ill.
STUDY DESCRIPTION: AN ENVIRONMENTAL COMPARISON OF FUTURE URBAN-TRANSPORTATION ALTERNATIVES
D. O. Moses (DOE, Washington, D.C.) and Sarah J. LaBelle 1980 26 p refs Presented at the 3rd World Energy Congr., Atlanta, 14-16 Oct. 1980
(Contract W-31-109-eng-38)
(CONF-801076-5) Avail: NTIS HC A03/MF A01

The transportation sector directly consumes one quarter of the energy used in this country with auto passenger travel accounting for half of the transport sector's energy supply. Due to rapidly rising fuel prices and intermittent supply shortages, Federal, state, and local government have begun to introduce various strategies (combinations of policies and technologies) designed to conserve urban transportation energy while maintaining a productive economy. The environmental consequences of many of the conservation strategies have not been adequately assessed. As a result, a technology assessment project is underway. The project will concentrate on the effects of alternative conservation strategies for the efficient movement of people in urban areas. The goals of the project are to provide: a description of several alternative strategies promoting energy conservation in the urban passenger transportation sector; a better understanding of the environmental impacts of such strategies; and an identification of the constraints to the implementation of such strategies. DOE

N81-31184*# Kentron International, Inc., Hampton, Va.
DESIGN AND ANALYSIS OF A FUEL-EFFICIENT SINGLE-ENGINE, TURBOPROP-POWERED, BUSINESS AIRPLANE
G. L. Martin, D. E. Everest, Jr., W. A. Lovell, J. E. Price, K. B. Walkley, and G. F. Washburn Hampton, Va. NASA. Langley Research Center Aug. 1981 37 p refs
(Contract NAS1-16000)
(NASA-CR-165768) Avail: NTIS HC A03/MF A01 CSCL 01C

The speed, range, payload, and fuel efficiency of a general aviation airplane powered by one turboprop engine was determined and compared to a twin engine turboprop aircraft. An airplane configuration was developed which can carry six people for a noreserve range of 2,408 km at a cruise speed above 154 m/s, and a cruise altitude of about 9,144 m. The cruise speed is comparable to that of the fastest of the current twin turboprop powered airplanes. It is found that the airplane has a cruise specific range greater than all twin turboprop engine airplanes flying in its speed range and most twin piston engine airplanes flying at considerably slower cruise airspeeds. E.A.K.

N81-31195*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCED SUBSONIC TRANSPORT PROPULSION
Donald L. Nored, Carl C. Ciepluch, Roger Chamberlain, Edward T. Meleason, and Gerald A. Kraft 1981 32 p refs Presented at the Intern. Air Transportation Conf., Atlantic City, N.J. 26-28 May 1981; sponsored by AIAA and SAE
(NASA-TM-82696; E-979) Avail: NTIS HC A03/MF A01 CSCL 21E

A brief review of the current NASA Energy Efficient Engine (E(3)) Project is presented. Included in this review are the factors that influenced the design of these turbofan engines and the advanced technology incorporated in them to reduce fuel consumption and improve environmental characteristics. In addition, factors such as the continuing spiral in fuel cost, that could influence future aircraft propulsion systems beyond those represented by the E(3) engines, are also discussed. Advanced technologies that will address these influencing factors and provide viable future propulsion systems are described. The potential importance of other propulsion system types, such as geared fans and turboshaft engines, is presented. T.M.

N81-31309# Committee on Science and Technology (U. S. House).
ADVANCED COAL COMBUSTION SYSTEMS
Washington GPO 1980 337 p refs Hearings before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 162, 16-17 Sep. 1980
(GPO-69-289) Avail: Subcomm. on Energy Development and Applications

An overview of clean coal technologies is given taking into consideration the concerns of the environmental and industrial sectors. Coal alternatives that can be made available to satisfy policies for increased coal utilization and environmental protection are discussed. These include: advanced pulverized coal plants in which the environmental control is integrated to minimize both its complexity and lack of reliability, atmospheric fluidized bed combustion, pressurized fluidized bed combined cycle plants, and gasification combined cycles. Factors which effect the selection of a particular advanced technology are addressed. J.M.S.

N81-31381# Committee on Commerce, Science, and Transportation (U. S. Senate).
METHANE TRANSPORTATION RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1980
Washington GPO 1980 165 p refs Joint Hearing on H.R. 6889 before the Subcomm. on Energy Res. and Develop. of the Comm. on Energy and Nat. Resources and the Subcomm. on Sci., Technol., and Space of the Comm. on Com. Sci., and Transportation, 96th Congr., 2nd Sess., 23 Sep. 1980
(Publ-96-126; GPO-70-504) Avail: NTIS Avail: Subcommittee on Energy Research and Development

A bill is presented which would provide a program for advanced and accelerated research into methane vehicle design, methane distribution systems, and methane storage facilities. It would also demonstrate the economic and technological practicalities of methane fueled vehicles for fleet use and onfarm operations. The Department of Energy would be the lead agency to conduct this research, development, and demonstration program. The bill would result in the initiation of 50 fleet demonstrations, of no less than 50 vehicles each, over the next 3 years. R.C.T.

N81-31382# Committee on Banking, Finance and Urban Affairs (U. S. House).
SYNTHETIC FUEL OVERSIGHT HEARING
Washington GPO 1981 99 p Hearing before the Subcomm. on Econ. Stabilization of the Comm. on Banking, Finance and Urban Affairs, 97th Congr., 1st Sess., 3 Mar. 1981.
(GPO-76-079) Avail: Subcommittee on Economic Stabilization

Current programs in the development of synthetic fuel technology and supplies are described. Emphasis is placed on rapid development to ensure greater independence from foreign energy supplies. Progress in coal liquefaction, coal gasification, and oil recovery, is discussed in relationship to the synthetic fuels programs. T.M.

N81-31383# Committee on Commerce, Science, and Transportation (U. S. Senate).
ENERGY FROM OPEN OCEAN KELP FARMS
Washington GPO 1980 87 p refs Presented to the Comm. on Com., Sci., and Transportation, 96th Congr., 1st Sess., Sep. 1980 Prepared by Office of Technology Assessments
(GPO-51-285) Avail: Committee on Commerce, Science, and Transportation

The problems and opportunities associated with developing ocean farms which would use giant kelp as a biomass source of energy are described. The possibilities of kelp are examined in terms of the status of the technology in general, its potential, the problems involved, and the Federal role in this segment of alternative energy research. R.C.T.

N81-31384# Committee on Agriculture (U. S. House).
ALCOHOL FUELS
Washington GPO 1980 109 p refs Joint hearings before the Comm. on Sci. and Technol. and the Comm. on Agr., 96th Congr., 2nd Sess., No. 176, 2 Oct. 1980
(GPO-70-454) Avail: Committee on Science and Technology

The plans of DOE and USDA to implement a major program for the production of alcohol fuels from biomass energy resources are examined. Emphasis is placed on the effect of such conversion technology on the food supply. Specific factors considered include regional feedstocks based on surpluses and/or wastes, cogeneration projects, and cellulosic conversion and utilization of agricultural wastes and residues for methane production. J.M.S.

N81-31385# Committee on Energy and Natural Resources (U.S. Senate).
SYNFUELS FROM COAL AND THE NATIONAL SYNFUELS PRODUCTION PROGRAM: TECHNICAL, ENVIRONMENTAL, AND ECONOMIC ASPECTS
Paul F. Rothberg, John R. Justus, James E. Mielke, F. Angelyn Wells, Judith A. Katzoff, Robert E. Trumbule, Malcolm M. Simmons, Alvin Kaufman, and Susan J. Bodilly Washington GPO 1981 312 p refs Presented to the Comm. on Energy and Nat. Resources, 9th Congr., 1st Sess., Jan. 1981 Prepared by the Congressional Research Service, Library of Congress
(GPO-71-047; Publ-97-3) Avail: SOD HC

The regulatory framework associated with the emerging coal-based synthetic fuels (synfuels) industry was examined. Federal programs affecting the commercialization of this industry were reviewed and analyzed, and areas for possible congressional oversight and additional action are indicated. The Federal programs are an interim program and a long range program. The interim program can be divided into the Department of Energy's (DOE) Alternative Fuels Production Program, and a joint DOE-Department of Defense (DOD) program which allows funding for synfuels projects under amendments to the Defense Production Act. The long range program will be conducted by the United States Synthetic Fuels Corporation (SFC), an independent Federal entity which will function primarily as an investment bank to accelerate the commercialization of synfuels. DOE

N81-31555# Corporate Tech Planning, Inc., Waltham, Mass.
REVIEW OF ALTERNATE AUTOMOTIVE ENGINE FUEL ECONOMY Final Report, Jan. - Oct. 1978
David Cole, Jay A. Bolt, Paul Huber, and Theodore Taylor, Jr.
Nov. 1980 72 p refs
(Contract DOT-HS-7-01789)
(PB81-186652; DOT-HS-805810) Avail: NTIS
HC A04/MF A01 CSCL 13F

The potential of alternate automotive engines to meet the fuel economy goals and emission levels of the 1980-1990 period is assessed. Those developments offering viable substitutes fo the current spark ignition engine systems are reviewed. Categories assessed included stratified charge, diesels, turbo charging, rotary/Wankel engines, and the developmental gas turbine and Stirling cycle engines. GRA

N81-31606# Committee on Energy and Natural Resources (U.S. Senate).
WORLD PETROLEUM OUTLOOK, 1981
Washington GPO 1981 155 p refs Hearing before the Comm. on Energy and Nat. Resources, 97th Congr., 1st Sess., 22 Jan. 1981
(Publ-97-4; GPO-74-059) Avail: Committee on Energy and Natural Resources

The impact of the Iraq/Iran conflict and the resultant decrease in OPEC oil production on stocks of crude oil and distillates in the United Stees is considered as well as causes of fuel shortages in New England. Methods are proposed for assuring that holders of petroleum stocks, utilities, and industries use current supplies to act as a buffer against possible shortages. A.R.H.

N81-31635# Joint Economic Committee (U. S. Congress).
ENERGY CONSERVATION: EMERGING CONSENSUS, DIVERGING COMMITMENT
Washington GPO 1980 43 p refs Presented to the Subcomm on Energy of the Joint Econ. Comm., 96th Congr., 2nd Sess., 31 Dec. 1980
(GPO-72-109) Avail: SOD HC

The role of energy conservation in national energy policy is considered. Energy conservation is defined. The level of Federal financial incentives for energy conservation and energy production is examined. It is concluded that the financial incentives for energy production are seven times greater than those for energy conservation. The impact of the bias against energy conservation on national energy security is discussed. J.D.H.

N81-31637# Committee on Science and Technology (U. S. House).
FLORIDA'S RENEWABLE ENERGY POTENTIAL
Washington GPO 1980 229 p refs Hearing before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., No. 166, 16 May 1980
(GPO-68-757) Avail: Subcommittee on Energy Development and Applicatons

Developments in the commercialization of biomass, solar energy conversion, and other renewable energy sources are considered. The role and performance of the Southern Solar Energy Center are reviewed, and solar energy conversion projects surveyed. The production of fuel alcohol from biomass is discussed. The use of forest biomass and tree farming for biomass is considered for cogeneration and for thermal energy production. Sources of waste biomass are identified. J.D.H.

N81-31638# Committee on Science and Technology (U. S. House).
COGENERATION
Washington GPO 1980 608 p refs Hearings before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci and Technol., 96th Congr., 2nd Sess., No. 155, 22-23 Jul 1980
(GPO-68-746) Avail: NTIS · Avail: Subcommittee on Energy Development and Applications

Portions of the National Gas Policy Act the Fuel Use Act, and the Public Utility Regulatory Policies Act all offer financial and regulatory breaks for cogeneration. Some of these incentives, however, work at cross purposes, creating confusion about Federal intentions and national goals for conservation and primary fuel use. The nature and scope of the conflicts and what the Government needs to do to increase use of cogenerations systems are discussed especially since direct coal combustion technologies, novel heat engines, solar thermal power systems, and other technologies under development are made more economically attractive when cogeneration applications are considered. A.R.H.

N81-31640# Oak Ridge National Lab., Tenn. Health and Safety Research Div.
RELATIVE ENERGY RISK: IS SOLAR ENERGY RISKIER THAN NUCLEAR
Herbert Inhaber 1981 19 p refs
(Contract W-7405-eng-26)
(CONF-810542-3) Avail: NTIS HC A02/MF A01

The discussion of risk analysis is divided into three parts: (1) a discussion of the methodology which can be used; (2) a listing of some of the major assumptions; and (3) the results of a comparison of eleven energy systems. The energy systems considered are divided into two groups: conventional, i.e., those in fairly widespread use, like coal or nuclear, and nonconventional, i.e., all others, like solar and wind. Compared to some conventional systems like natural gas and nuclear, technologies like solar and windpower have relatively high risk. Because of the dilute nature of the energy they handle, solar and wind systems, when compared on the quality of their energy production, require a considerable amount of apparatus as compared to other systems. In turn, this apparatus requires a large amount of material and construction labor to build and install. Associated with each ton of material and hour of labor is a definite number of accidents, diseases and deaths, according to labor statistics. DOE

N81-31642# Westat Research, Inc., Rockville, Md.
NONRESIDENTIAL BUILDING ENERGY CONSUMPTION SURVEY Final Report
Mar. 1981 223 p refs
(Contracts DE-AC01-78EI-06389; EI-78-C-016389)
(DOE/EIA-0288) Avail: NTIS HC A10/MF A01

A building survey designed to provide data on the characteristic of a building's structure, activities inside the building, heating and air conditioning equipment, and the types and uses of energy consumed, is described. The sample selection plan is included. A total of 7322 nonresidential buildings were selected and 6222 interviews were completed. The tasks performed in order to select the samples and interview appropriate respondents knowledgeable about their building's characteristics, operations, and energy use are detailed. DOE

N81-31644# Barton-Aschmann Association, Inc., Evanston, Ill.
OVERVIEW OF ENERGY-CONSERVING DEVELOPMENT PLANNING AND DESIGN TECHNIQUES BASED ON FIVE CASE STUDIES
Jun. 1980 229 p refs
(Contract W-31-109-eng-38)
(ANL/CNSV-TM-59) Avail: NTIS HC A11/MF A01

Ways to conserve energy through development planning and site design in five old, new, and planned communities are presented. Two approaches were used: (1) a conventional, preexisting plan was analyzed to determine potential energy use; (2) energy conservation options were independently identified and evaluated. DOE

N81-31646# Center for Research on the Acts of Man, Philadelphia, Pa.
MODELING ENERGY AND SOCIETY: THEORY AND METHOD IN ASSESSING THE SOCIAL EFFECTS OF ENERGY POLICIES. VOLUME 1: EXECUTIVE SUMMARY Final Report
Samuel Z. Klausner and Robert H. Edelstein Dec. 1980 15 p 3 Vol.
(Contract FEA-CO-04-60588-00)
(DOE/TIC-1022359) Avail: NTIS HC A02/MF A01

A positive correlation is found between unemployment and per-capita energy use. The social theory upon which the study model is based anticipates this otherwise counterintuitive finding. It is not the number of men or machines at work but the number of social roles and the intensity of activity in those roles which determine the level of energy consumption. The feasibility is assessed of a society/energy model which, when completed, may be used to monitor and to forecast the social effects of energy policies. Such is found to be feasible. DOE

N81-31648# Center for Research on the Acts of Man, Philadelphia, Pa.
MODELLING ENERGY AND SOCIETY: THEORY AND METHOD IN ASSESSING THE SOCIAL EFFECTS OF ENERGY POLICIES. VOLUME 3: THE MEASUREMENT MODEL Final Report
Samuel Z. Klausner and Robert H. Edelstein Dec. 1980 146 p refs 3 Vol.
(Contract FEA-CO-04-60588-00)
(DOE/TIC-1022361) Avail: NTIS HC A07/MF A01

A mathematical statement is presented of typical equations expressing causal relations between measures of physical energy consumption and both the attributes of various social institutions and the behavior of actors in those institutions. A way of testing the proposed model with empirical data is demonstrated. National, annualized time-series data from published sources for the period from 1960 to 1974 were used, and empirical tests of the model were limited to three strategic types of energy policies: those involving fuel price controls; changes in employment rates; and changes in economic output. DOE

N81-31660# Colorado School of Mines, Golden. Research Inst.
STATE ENERGY MODELING. VOLUME 1: AN ANALYSIS OF STATE ENERGY MODELING
Albert G. Melcher 30 May 1981 85 p 2 Vol.
(Contract DE-AC02-79CS-10046)
(DOE/CS-10046/2-Vol-1) Avail: NTIS HC A05/MF A01

An inventory and analysis of state energy models were made. The inventory identified 69 models developed or used at the state government level. Most of these deal with energy demand and area mix as regards the sectors modeled and the fuel types included. Nearly all of these are econometric or econometric engineering end use models. Fewer models deal with energy supply, and several address both supply and demand. The most common types of models are econometric, engineering and use, linear programming, and input-output. Purposes of models include: forecasting; policy analysis; impact analysis; and scenario analysis. Uses include short term emergency management, long term strategic assessment, and specific applications in decisions on facility siting, utility capacity expansion and rate increases proposed legislation, and analysis of federal policy. DOE

N81-31661# Colorado School of Mines, Golden. Research Inst.
ENERGY MODELING. VOLUME 2: INVENTORY AND DETAILS OF STATE ENERGY MODELS
Albert G. Melcher, Robert G. Underwood, Joseph C. Weber, Fionald L. Gist, Roger P. Holman, and Dennis W. Donald 30 May 1981 295 p refs 2 Vol.
(DOE/CS-10046/2-Vol-2) Avail: NTIS HC A13/MF A01

An inventory of energy models developed by or for state governments is presented, and certain models are discussed in depth. These models address a variety of purposes such as: supply or demand of energy or of certain types of energy; emergency management of energy; and energy economics. Ten models are described. The purpose, use, and history of the model is discussed, and information is given on the outputs, inputs, and mathematical structure of the model. The models include five models dealing with energy demand, one of which is econometric and four of which are econometric-engineering end-use models. DOE

N81-31674# New England Council of Water Center Directors, Boston, Mass.
WATER, ENERGY, AND ECONOMIC DEVELOPMENT TOWARDS AN INTEGRATED REGIONAL POLICY ANALYSIS SYSTEM: SELECTED BACKGROUND ESSAYS
Rudolph W. Hardy, ed. Dec. 1980 46 p refs
(Contract DI-14-34-0001-9412)
(PB81-184129; WB1-02431;
OWRT-C-90071-G/C-00191-G9412-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Background essays for the project: water, energy, and economic development towards an integrated regional policy analysis system are reported. A write up for a preliminary systems dynamic model is included. The following topics are addressed: (1) planning theory; (2) institutional impacts of energy systems (the problem of scale); (3) regional incidence of investment and welfare; (4) innovation in the public sector; and (5) description of a preliminary model for the study of interactions among water, energy, and economic development. GRA

N81-31683# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
DISTRICT HEATING: AIR-QUALITY CONSIDERATIONS AND THE CLEAN AIR ACT

P. D. Moskowitz, T. Carney, and F. W. Lipfert Jan. 1981 24 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51361) Avail: NTIS HC A02/MF A01

The advantages of a district heating facility arise from increases in overall energy utilization efficiency and the ability to use coal or nuclear fuels as energy sources and thus reduce dependence on more limited energy resources such as oil or natural gas. It is suggested that commercialization of the district heating concept is likely to reduce regional production of environmental residuals, even though local burdens could increase. Although site specific production of emissions could increase, it is shown that local air quality will not be degraded. It is concluded that although air quality benefits could be accrued nonattainment requirements of the Clean Air Act may present a barrier to implementation. DOE

N81-31685# Aerospace Corp., Germantown, Md.
OIL SHALE SURFACE RETORTING: ENVIRONMENTAL CHARACTERIZATION INFORMATION REPORT
Jan. 1981 68 p refs
(Contract DE-AT03-76EV-74010)
(DOE/EP-0015) Avail: NTIS HC A04/MF A01

Environmental Characterization Information Report for Oil Shale, Surface Retorting: Paraho Process (Direct Mode) is described. The plant chose for characterization is a syncrude equivalent facility using the Paraho Process (Direct Mode). The process, assumed plant operating parameters, resources needed, and the environmental residuals and products associated with the plant are presented. Annual resource usage and pollutant discharges are shown in English and metric units, assuming an annual plant capacity factor of 90 percent. Twenty-one environmental points of interest are discussed individually. DOE

N81-31691# Jacobs Engineering Co., Pasadena, Calif.
ENVIRONMENTAL PERSPECTIVE ON THE EMERGING OIL SHALE INDUSTRY. VOLUME 2: APPENDICES
Edward R. Bates, ed. and Terry L. Thoem, ed. Denver EPA Apr. 1981 442 p refs
(Contract EPA-68-03-2569)
(PB81-196602; EPA-600/2-80-205B) Avail: NTIS HC A19/MF A01 CSCL 13B

The following appendices are included: status and development of the oil shale industry; procedures for ambient air monitoring; environmental monitoring activities; applicable Federal, state and local legislation, standards and regulations; quality assurance bibliography; Federal and state permits required for operation of an oil shale facility. GRA

N81-31692# Pennsylvania State Univ., University Park.
FIELD TESTS OF INDUSTRIAL STOKER COAL-FIRED BOILERS FOR EMISSIONS CONTROL AND EFFICIENCY IMPROVEMENT, SITES L1-L7 Final Report, Feb. 1978 - May 1979
J. W. Davis and H. K. Owens Feb. 1981 67 p Sponsored in part by the American Boiler Manufacturers Assn.
(Contracts EPA-IAG-D7-E681FZ; DOE-EF-77-C-01-2609)
(PB81-196628; EPA-600/7-81-020A) Avail: NTIS HC A04/MF A01 CSCL 13B

Results of field measurements to determine particulate emission rate and particle size distribution for seven institutional type stoker fired boilers firing bituminous coals are given. Operational data were recorded during the tests to provide information for evaluating boiler emission as a function of boiler load, heat release rates, coal size and characteristics, percent excess combustion air, and flue gas temperature. All boilers were tested under normal operating conditions at loads of 50-75 percent of maximum boiler capacity. The types of stokers tested included single retort underfeed, multiple retort underfeed, traveling grate overfeed, and vibrating grate overfeed. GRA

N81-31695# Environmental Sciences Research Lab., Research Triangle Park, N.C.
FILTER MEDIA FOR COLLECTING DIESEL PARTICULATE MATTER
Frank Black and Lisa Doberstein May 1981 37 p refs
(PB81-197774; EPA-600/2-81-017) Avail: NTIS HC A03/MF A01 CSCL 13B

Certification of particulate emissions from diesel motor vehicles involves filtration of measured aliquots of the total air diluted exhaust. Seven commercially available filter media were examined for this purpose. The media included a variety of PTFE membrane filters, glass fiber filters, and PTFE coated glass fiber filters. Relative flow resistance (pressure drop), collection efficiency, and gas phase adsorption were examined. The results obtained indicate that under the defined test conditions the membrane filters yield low gram per mile emissions rates due to difficulties with collection of Federal Test Procedure phase 1 emissions, and the Gelman A-E glass fiber filter high rates due to adsorption of gas phase emissions. GRA

N81-31696# Battelle Columbus Labs., Ohio.
EVALUATION OF EMISSIONS AND CONTROL TECHNOLOGY FOR INDUSTRIAL STOKER BOILERS Final Report, Oct. 1977 - Oct. 1980
Robert D. Giammar, Russell H. Barnes, David R. Hopper, Paul R. Webb, and Albert E. Weller May 1981 266 p refs
(Contract EPA-68-02-2627)
(PB81-197873; EPA-600/7-81-090; IERL-RTP-1187) Avail: NTIS HC A11/MF A01 CSCL 13B

Emission characteristics were determined for a variety of coals fired in a 200-kW stoker boiler. It was observed that significant amounts of sulfur were retained in the lignite and western subbituminous coals. Fuel nitrogen conversion to NO was found to be between 10 and 20%. In addition, a limestone/coal fuel pellet was developed and found effective in capturing 80% of the fuel sulfur. Using an 8-MW spreader stoker boiler, it was found that improved control of combustion air (i.e., underfire and overfire air) resulted in lower excess air operation (improved efficiency), reduced particular loading, smoke, CO and NO emissions and no effect on SO2 levels. The limestone/coal pellet (Ca/S=7) was successfully fired, achieving 75% SO2 reduction. GRA

N81-31697# Missouri Univ.-Columbia. Dept. of Chemistry
INTERCHANGE OF POLLUTANTS BETWEEN GROUNDWATER AND AND MINERAL STRATA AS APPLIED TO WASTE CHEMICAL DUMPS AND IN SITU COAL GASIFICATION SITES Completion Report, 1 Oct. 1979 - 30 Sep. 1980
Stanley E. Manahan, Paul Tobben, Robert Gale, Steven Hoeffner, and Darryl Bornhop 15 Mar. 1981 19 p refs
(Contract DI-14-34-0001-0127)
(PB81-198335; W81-02714; OWRT-A-117-MO(1)) Avail: NTIS HC A02/MF A01 CSCL 13B

Particular emphasis was placed upon the development of methods to evaluate the chemical interaction between contaminated groundwaters and specific solids so that these methods could be applied to specific situations which other investigators might need to study. Of particular importance was the development of methods to obtain chemical data which in turn can be used to provide meaningful bases for modelling groundwater contamination. Water contaminated by vapor from laboratory-simulated in situ coal gasification was employed as a model polluted water. The solids used to sorb organics from this waster were subbituminous coal, non-activated coal char, activated coal char, and coal ash. GRA

N81-31822# Oak Ridge National Lab., Tenn.
DOING A RISK ANALYSIS
H. Inhaber 1981 18 p Presented at the 2nd Ann. Eastern Reg. Safety Congr., Philadelphia, 30 Apr. 1981
(Contract W-7405-eng-26)
(CONF-810480-1) Avail: NTIS HC A02/MF A01

The methodologies which can be used to determine the overall risk of any energy system are outlined. Termed risk accounting, it is calculated in analogy to energy accounting, which attempts to determine all the energy inputs into a system in comparison to the net output. The most important conclusion of this analysis is that the risk from non-conventional energy sources can be as high as, or even higher than that of conventional sources. In particular, it tends to be considerably higher than that of nuclear power, the newest of the conventional sources. The ratio is, in some cases, as high as 10 or 100. The results can be divided into occupational risk, borne by those who construct, fabricate and maintain the energy sources, and danger to members of the public. The total risk of a system is then the sum of occupational and public risk. The occupational man-days lost per unit energy averaged over the system lifetime are given. DOE

N81-32077# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
TRANSFER OF INFORMATION FROM RESEARCHER TO CONSUMER: CHOOSING THE APPROPRIATE MEDIA
Dan Halacy May 1981 5 p refs Presented at the AS/ISES Special Interest Group on Energy and Environ. Inform. Conf., Denver, 11 May 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-613-1193; CONF-810560-1) Avail: NTIS HC A02/MF A01

The diffusion of solar innovations is discussed. The objectivity, timeliness, comprehensiveness, and clarity of marketing and commercial messages are reviewed. DOE

N81-32088*# Transportation Systems Center, Cambridge, Mass.
FUEL ECONOMY AND EXHAUST EMISSIONS CHARACTERISTICS OF DIESEL VEHICLES: TEST RESULTS OF A PROTOTYPE FIAT 131 NA 2.4 LITER AUTOMOBILE
S. S. Quayle, M. M. Davis, and R. A. Walter May 1981 82 p refs
(NASA Order C-32817-D; Contract DE-AI01-80CS-50194)
(NASA-CR-165281; DOE/NASA/281751; DOT-TSC-NASA-81-1) Avail: NTIS HC A05/MF A01 CSCL 13B

The vehicle was tested on a chassis dynamometer over selected drive cycles and steady-state conditions. Two fuels were used, a U.S. no. 2 diesel and a European diesel fuel. The vehicle was tested with retarded timing and with and without an oxidation catalyst. Particulate emission rates were calculated from dilution tunnel measurements and large volume particulate samples were collected for biological and chemical analysis. It was determined that while the catalyst was generally effective in reducing hydrocarbon and carbon monoxide levels, it was also a factor in increasing particulate emissions. Increased particulate emission rates were particularly evident when the vehicle was operated on the European fuel which has a high sulfur content. T.M.

N81-32092# Falcon Research and Development Co., Buffalo, N. Y.
DYNAMOMETER AND TRACK MEASUREMENT OF PASSENGER CAR FUEL ECONOMY Final Report
Jeffrey Bernard and Sol Kaufman Mar. 1981 137 p refs
(Contract EPA-68-03-2835)
(PB81-196446; EPA-460/3-81-002) Avail: NTIS HC A01/MF A01 CSCL 13F

The factors contributing to differences in fuel economy measured on a road in consumer service as compared to EPA estimates using a dynamometer are considered. The relationship between the fuel economy of production cars tested on dynamometer equipment and the fuel economy they achieve when operated over the same driving sequence on a test track is analyzed. The test track simulates a subset of driving conditions that might be encountered in actual driving. GRA

N81-32299# Water Resources Council, Washington, D.C.
SYNTHETIC FUEL DEVELOPMENT FOR THE UPPER MISSOURI RIVER BASIN. SECTION 13A: WATER ASSESSMENT REPORT
Apr. 1981 124 p refs
(Contract DE-AI01-76EV-03201)
(DOE/EV-03201/T4) Avail: NTIS HC A06/MF A01

The availability of water to support synfuel development for three types of coal conversion technologies and to identify major effects that synfuel development could have on the water resources of the region were assessed. Surface water is generally available in the Upper Missouri River basin to support coal conversion development. Approximately 700,000 acre-feet of surface water are available annually in the Boysen and Yellowtail Reservoirs on the Brighorn River, pending completion of environmental impact statement and water availability studies by the US Water and Power Resources Service. Existing single- and multiple-purpose water supply systems in the Upper Missouri would require major modification and expansion to enable the use of water supplies for regional coal conversion development. Possible considerations to provide water at desired plant locations include new storage, interbasin transfers, changes to present water use, and groundwater development. The operations of some reservoirs in the Yellowstone River Basin may need to be altered to assure sufficient flows for energy needs during dry years. DOE

N81-32611# Committee on Interstate and Foreign Commerce (U. S. House).
POTENTIAL DISPLACEMENT OF OIL BY NUCLEAR ENERGY AND COAL IN ELECTRIC UTILITIES
Washington GPO 1981 397 p refs Hearing before the Subcomm. on Oversight and Invest. of the Comm. on Interstate and Foreign Com., 98th Congr., 2nd Sess., 9 Dec. 1980
(GPO-72-081) Avail: Subcommittee on Oversight and Investigations

Discrepancies exist between estimates of the amount of oil displaced by nuclear fuels or coal in 1979 as determined by DOE and other researchers. Future trends in utility fuel use are discussed from the point of view of construction, replacement, energy costs to consumer, availability of fossil fuels (other than oil), and site selection. A.R.H.

N81-32618# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany).
HEAT RECOVERY FROM WASTE WATER BY ENERGY-SAVING HEAT PUMP SYSTEMS IN CONNECTION WITH WATER TREATMENT PLANTS
U. Wiedmann and Rudolf Flohrschuetz Apr. 1980 287 p refs In GERMAN; ENGLISH summary Sponsored by Budesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-022) (US Sales Only) HC A13/MF A01; DOE Depository Libraries

The advantages of waste water recovery as an energy source were investigated. It was found that heat pump systems reach the highest performance coefficients and their primary energy ratios are competitive with conventional heating systems. It is concluded that the utilization of waste water treatment plants by large heat pump systems provides a considerable annual energy saving of light oil. Transl. by E.A.K.

N81-32638# Department of Energy, Washington, D. C.
SECURING AMERICA'S ENERGY FUTURE: THE NATIONAL ENERGY POLICY PLAN
Jul. 1981 37 p
(DOE/S-0008) Avail: NTIS HC A03/MF A01

Energy policy guidelines within the context of the overall economic recovery program were reformulated. The new national energy policy continues to develop and to be refined; it will not be tied to a static and unresponsive plan. The approach for reformulation of policy energy is defined, and the current energy outlook of the Nation is presented. DOE

N81-32649# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ENVIRONMENTAL AND ECONOMIC COMPARISONS OF THE SATELLITE POWER SYSTEM AND SIX ALTERNATIVE ENERGY TECHNOLOGIES
R. G. Whitfield, L. J. Habegger, E. P. Levine, and E. A. Tanzman Apr. 1981 129 p refs
(Contract W-31-109-eng-38)
(ANL/EES-TM-136) Avail: NTIS HC A07/MF A01

The satellite power system (SPS) was compared with alternative systems on life cycle cost and environmental impacts. Environmental and economic effects are evaluated and subdivided into the following issue areas: human health and safety, environmental welfare, resources (land, materials, energy, water, labor), macroeconomics, socioeconomics, and institutional. These evaluations are based on technology characterization data and alternative futures scenarios, developed as part of CDEP. The technologies and the scenarios are described. The cost and performance of the SPS and the alternative technologies provide the basis of the macroeconomic analyses. DOE

N81-32858# National Center for Appropriate Technology, Butte, Mont.
USA: LIVING WITH THE SUN
K. Collins, Edwin Kepler, John McBride, Cindi Rucker, and Jon Sesso Jul. 1981 31 p Sponsored in part by Dept. of State and US Community Services Administration
(Contract DE-AP01-811A-10191)
(DE81-027832; DOE/CE-0017) Avail: NTIS HC A03/MF A01

This illustrated brochure describes and shows renewable energy demonstration projects across the country. Solar energy, biomass, windpower, and waterpower projects are included. L.F.M.

N81-32686# Argonne National Lab., Ill.
PLANNING FOR ENERGY CONSERVATION: THE COMMUNITY IS THE KEY
Isiah Sewell and Kevin Croke (Illinois Univ., Chicago) 1981 7 p refs Presented at the Intersoc. Energy Conversion Conf., Seattle, 17-22 Aug. 1981
(Contract W-31-109-eng-38)
(DE81-023118; CONF-810822-1) Avail: NTIS HC A02/MF A01

The concept of viewing a community as a related set of energy demands and supplies in an effort to develop more-effective energy-planning procedures in the United States is explored. Integrated energy planning programs in Sweden and Germany were examined, as well as several projects being sponsored in the United States. Impediments to adopting an integrated planning approach are also discussed. Energy efficiency and conservation are attained mainly through the efficient planning and cost-effective delivery of each separate energy form. An alternate view of the community is to conceive of it as a group of inter-related, end-use markets which generate demands for usable energy. This latter concept of usable energy emphasizes not its form as electricity, oil, or natural gas but rather to its quality (temperature) and its location. DOE

N81-32691# Argonne National Lab., Ill.
OCEAN ENERGY RESOURCES: THE IMPACT OF OTEC
John D. Ditmars 1980 10 p refs Presented at the Conf. on Climate and Offshore Energy Resources, London, 21-23 Oct. 1980
(Contract W-31-109-eng-38)
(DE81-023916; CONF-8010198-1) Avail: NTIS HC A02/MF A01

The status ocean thermal energy conversion (OTEC) technological development is summarized. The potential impacts of OTEC power production on the ocean environment, including implications for impacts on climate is emphasized. DOE

N81-32700# Energy and Environmental Analysis, Inc., Arlington, Va.
INDUSTRIAL ENERGY USE PROJECT Annual Report, 1979 - 1980
M. Lerner, A. Sarin, D. Hauth, and V. S. Kothari Oct. 1980 138 p refs
(Contract GRI-5014-342-0185)
(PB81-201899; GRI-79/0076) Avail: NTIS HC A07/MF A01 CSCL 10A

The industrial energy use project was studied. The following objectives were outlined: (1) to determine energy use data disaggregated to the process level for all industries; (2) identify technological options to improve efficiency of gas consuming furnaces; and (3) recommend research priorities for improving the efficiency of industrial gas use. Furnaces used in the glass and iron and steel industries are examined. A detail mathematical model for heat transfer processes inside a glass regenerative melting furnace is presented. The model simulates effects of various energy conservation options on furnace operation and performance. Major inefficiencies in furnaces in the glass and iron and steel industries are discussed and available energy conservation and fuel switching options are identified. GRA

N81-32702# Battelle Columbus Labs., Ohio.
ENERGY RECOVERY IN NATURAL GAS DEPRESSURIZING STATIONS Final Report, Jun. - Dec. 1980
John M. Corliss and David E. Jones 9 Apr. 1981 50 p refs
(Contract GRI-5015-310-0281)
(PB81-201972; GRI-79/0107) Avail: NTIS HC A03/MF A01 CSCL 10B

Thermodynamic and economic analyses to determine the potential cost worthiness of depressurizing natural gas from transmission pressure to distribution pressure via turboexpansion as opposed to throttling are presented. The use of turboexpanders to generate electricity or provide shaft power for use on site is considered. Site selection criteria and regulatory impediments are discussed. GRA

N81-32705# Old West Regional Commission, Billings, Mont.
ENERGY RESEARCH INFORMATION SYSTEM PROJECTS REPORT, VOLUME 5, NUMBER 1 Progress Report, Jun. 1979 - Jul. 1980
Judith Johnson, comp. and Laura Schillinger, comp. Jul. 1980 104 p
(PB81-204992; OWRC/ERIS-8001) Avail: NTIS HC A06/MF A01 CSCL 08I

The system (ERIS) provides an inventory of the energy related programs and research activities from 1974 to the present in the states of Montana, Nebraska, North Dakota, South Dakota and Wyoming. Areas of research covered include coal, reclamation, water resources, environmental impacts, socioeconomic impacts, energy conversion, mining methodology, petroleum, natural gas, oilshale, renewable energy resources, nuclear energy, energy conservation and land use. Each project description lists title, investigator(s), research institution, sponsor, funding, time frame, location, a descriptive abstract of the research and title reports and/or publications generated by the research. All projects are indexed by location, personal names, organizations and subject keywords. GRA

N81-32706# Old West Regional Commission, Billings, Mont.
ENERGY RESEARCH INFORMATION SYSTEM PROJECTS REPORT, VOLUME 5, NUMBER 2 Report, Aug. - Dec. 1980
Judith Johnson, comp. Dec. 1980 102 p
(PB81-205007. OWRC/ERIS-8002) Avail: NTIS HC A06/MF A01 CSCL 08I

The system (ERIS) is a service administered by the Old West Regional Commission in response to the need for current information on research activities in the region's rapidly growing and changing field of energy. The ERIS compiles and makes available to the users in the Region an up to date inventory of ongoing and recently completed energy related research projects. The subject areas covered are: reclamation, energy conversion, and land use research, socioeconomic impact and renewable energy development which do not necessarily involve research. GRA

N81-32710# West Virginia Univ., Morgantown.
NO SUB x EMISSION FROM COMBUSTORS: A STATE-OF-THE-ART REVIEW
G. T. Chen, J. Y. Shang, and C. Y. Wen May 1981 95 p refs
(Contract DE-AM21-79MC-11284)
(DOE/MC-11284/166) Avail: NTIS HC A05/MF A01

The state-of-the-art of the theory and control of NOx emissions from combustors of thermal gases, and NOx emissions control technology and mathematical modeling of fluidized bed combustors are also discussed. DOE

N81-32711# Electric Power Research Inst., Palo Alto, Calif. Coal Combustion Systems Div.
PROCEEDINGS OF THE JOINT SYMPOSIUM ON STATIONARY COMBUSTION NO SUB x CONTROL, VOLUME 2
May 1981 368 p refs Symp. held at Denver, 6-9 Oct. 1980
(DE81-903302; EPRI-WS-79-220-Vol-2) Avail: NTIS HC A16/MF A01

For pulverized coal-fired utility boilers, postcombustion control, and emissions characterization of other combustion-generated species. Specifically selective catalytic reduction, commercial fuel gas treatment systems, and environmental assessment of NOx emissions from utility power plants and conventional combustion sources are discussed. J.M.S.

N81-32712# Mitre Corp., McLean, Va. METREK Div.
ENVIRONMENTAL EFFECTS OF COAL TECHNOLOGIES RESEARCH NEEDS
R. Brown Jun. 1981 234 p refs
(Contract DE-AC01-79EV-10018)
(MTR-79W-159-03) Avail: NTIS HC A11/MF A01

Environmental problems associated with conventional coal mining, storage, transportation, and combustion, and with chemical coal cleaning, in situ gasification, fluidized bed combustion, cocombustion of coal-oil mixtures, and cocombustion of coal with municipal solid waste are addressed. Recommended research required to address the identified problems is presented. The findings relate primarily to effects related research. DOE

N81-32713# Argonne National Lab., Ill. Engineering Div.
COMPARISON OF ANALYTICAL AND EXPERIMENTAL STUDIES OF NOx KINETICS IN MHD SYSTEMS
A. J. Sistino Feb. 1981 29 p refs
(Contract W-31-109-eng-38)
(ANL/MHD-80-17) Avail: NTIS HC A03/MF A01

In an open cycle MHD-steam system, the high temperature (2800 to 3000 K) in the coal/air combustor tends to produce high NO x levels (approx. 10,000 ppM) in the combustion products. These levels must be reduced to 550 ppM for stack emission acceptable under Environmental Protection Agency regulations. In order to meet the EPA requirement, the NOx concentration in the various system components must be determined, and certain of those components must be of new special design. In particular, the NOx composition in the MHD-steam system has been determined by modeling the chemical kinetics in the diffuser, the radiant boiler and the secondary combustor. A detailed description of the formulation of the chemical kinetics model is first given, which should aid understanding of NOx formation/decomposition in an MHD-steam system; then the results of studies using the chemical kinetics model are compared with available experimental results. DOE

N81-32714# Argonne National Lab., Ill. Engineering Div.
NITRIC OXIDE FORMATION IN MULTI-PARALLEL JET SECONDARY COMBUSTOR FOR MHD SYSTEM
P. M. Chung (Illinois Univ. at Chicago Circle), R. Scott Smith, John Haydweiller (Syracuse Univ., N.Y.), and Z. ElDerini Oct. 1980 54 p refs
(Contract W-31-109-eng-38)
(ANL/MHD-80-9) Avail: NTIS HC A04/MF A01

The minimum combustor length required for mixing and complete combustion in the limit of fast chemical kinetics was determined. This length is shorter than that required for uniform mixing. It is a moderate function of the jet spacing and is rather strongly dependent upon the stoichiometric air ratio. In the usual operating temperature range of 1600 to 2000 K and for the lengths up to about 5m, the NO sub X reactions in the secondary combustors are found to be nearly frozen. Therefore, ignition and combustion, rather than the nitric oxide formation, should be the secondary combustor design criterion. DOE

N81-32715# International Power Technology, Inc., Sunnyvale, Calif.
DESIGN AND TEST OF AN EXHAUST GAS CLEAN-UP SYSTEM FOR POWER PLANTS USING HIGH SULPHUR CONTENT FUELS Final Report
C. N. Cheng 10 Oct. 1980 140 p refs
(Contract DE-AC03-79ET-12442)
(DE81-026513; DOE/ET-12442/T2) Avail: NTIS HC A07/MF A01

This experimental program, initially designated to study an exhaust gas cleanup and water recovery system for a Cheng Cycle Dual-Fluid (CCDF) turbine power plant using sulfur rich fuels, has shown the potential of a general flue Gas Desulfurization (FGD) system applicable to utility and industrial boilers as well. The process was studied both theoretically and experimentally. Experiments were performed using a bench scale (25k equivalent) apparatus and a pilot scale (1Mw equivalent) apparatus. Data obtained indicated the process potentially can out-perform the conventional process with significant cost savings. DOE

N81-32717# Acurex Corp., Mountain View, Calif.
SURVEY AND EVALUATION OF MODERN ELECTROSTATIC CONCEPTS APPLIED TO HIGH-RESISIVITY FLY ASH
Clyde L. Stanley Dec. 1980 115 p refs
(Contract DE-AC18-80FC-10226)
(DE81-026204; DOE/FC-10226/T1) Avail: NTIS HC A06/MF A01

The ineffectiveness of conventional electrostatic precipitators on high resistivity fly ash has different, though interrelated, causes. A versatile multiple-concept pilot precipitator would allow GFETC to develop the optimum: combination of novel concepts. Acurex is recommmending a precipitator with component interchangeability in three sections: (1) the main precipitator section (one or more cells) should be designed to accept either conventional electrodes or a few tri-electrode configurations. Versatile pulse-charged power supplies will be needed to accommodate the various electrode configurations. The best method of suppressing back-corona in the precipitator itself can thus be developed; (2) a precharger section should be installed ahead of the main precipitator to optimize precharger design; and (3) a downstream collector section would test the effectiveness of concepts which lend themselves to effective collection of low-load, high-resisivity, small particles. These include wet precipitators, fabric filters, and bed filters. DOE

N81-32721# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ENVIRONMENTAL IMPLICATIONS OF THE LARGE-SCALE UTILIZATION OF ALCOHOL FUELS IN THE UNITED STATES
Oreste H. Bevilacqua (OMB Associates), Martin J. Bernard, III, and Daniel P. Maxfield (DOE) Oct. 1980 9 p ref Presented at the 4th Intern. Symp. on Alcohol Fuels Technol., Guaruja, Brazil, Oct. 1980
(Contract W-31-109-eng-38)
(DE81-023906; CONF-8010194-1) Avail: NTIS HC A02/MF A01

In this assessment, the environment is considered to include natural resource, ecological, physical environment, health and safety, and social-economic systems. The environmental assessment was based on the extrapolation and systematic analysis of existing data as to the characteristics of alcohol fuels and their performance in conventional engines. The major results and implications of this assessment are presented. DOE

N81-32722# Oak Ridge National Lab., Tenn. Industrial Safety and Applied Health Physics Div.
DESIGN OF THE OAK RIDGE NATIONAL LABORATORY STEAM PLANT AIR-QUALITY NETWORK IN COMPLEX TERRAIN
Eric S. Hougland (Tennessee Univ., Knoxville) and Thomas W. Oakes 1981 15 p refs Presented at the 74th Ann. Meeting of the Air Pollution Control Assoc., Philadelphia, 21 Jun. 1981
(Contract W-7405-eng-26)
(DE81-024087; CONF-810631-4) Avail: NTIS HC A02/MF A01

The conversion of the steam plant from oil and gas to coal fired operation is researched. The determination of the environmental impact of this coal burning on air pollution levels in the vicinity of the laboratory was studied. A model for the optimal design of an air quality monitoring system was used for the development of a network of samplers to monitor the air quality impacts of the fuel conversion. The extension of the system design project to include other major air pollution sources in the vicinity of Oak Ridge, more representative meteorologica data, and the exploit consideration of the complex terrain in the Oak Ridge area are discussed. DOE

N81-32726# Argonne National Lab., Ill.
ENVIRONMENTAL EFFECTS OF THE SATELLITE POWER SYSTEM MICROWAVE POWER TRANSMISSION SYSTEM
A. R. Valentino and M. M. Abromavage (Illinois Inst. of Technology, Chicago) 1980 6 p refs Presented at the Natl. Telecommun. Conf., Houston, Tex., 3 Dec. 1980
(Contract W-31-109-eng-38)
(DE81-023811; CONF-801261-1) Avail: NTIS HC A02/MF A01

The potential environmental effects of the satellite power system (SPS) microwave power transmission system were studied. Issues were identified including: (1) health effects due to microwave exposure for the public as well as the SPS worker; (2) effects on telecommunications due to ionospheric changes caused by the passage of the microwave beam; and (3) electromagnetic compatibility with military systems, radio astronomy, satellite systems, and electronic systems in general. DOE

N81-32727# Department of Energy, Washington, D. C. Geothermal Energy Div.
ENVIRONMENTAL ASSESSMENTAL, GEOTHERMAL ENERGY, HEBER GEOTHERMAL BINARY-CYCLE DEMONSTRATION PROJECT: IMPERIAL COUNTY, CALIFORNIA
Oct. 1980 310 p refs
(DOE/EA-0119) Avail: NTIS HC A14/MF A01

The proposed design, construction, and operation of a commecial scale (45 MWe net) binary cycle geothermal demonstration power plant, are described using the liquid dominated geothermal resources at Heber, Imperial County, California. The following are included in the environmental assessment: a description of the affected environment, potential environmental consequences of the proposed action, mitigation measures and monitoring plans, possible future development activities at the Heber anomaly, and regulations and permit requirements. DOE

N81-32736# Fish and Wildlife Service, Washington, D. C. Office of Biological Services.

NATIONAL COASTAL ECOLOGICAL RESEARCH: EXISTING AND PROPOSED ENERGY DEVELOPMENT
Sharon L. Gordon, Herbert L. Lundblad, and Carol A. Westcott Jan. 1981 174 p refs Prepared in cooperation with Aerospace Corp., El Segundo, Calif.
(Contract DI-14-16-0009-78-981)
(PB81-203192; FWS/OBS-81/11) Avail: NTIS HC A08/MF A01 CSCL 13B

An initial information base is provided for the U.S. Fish and Wildlife Service in allocating their resources when dealing with the impacts of coastal energy development of fish and wildlife resources. Included is a survey of the locations of existing and projected coastal energy development and an independent evaluation of energy development problems facing coastal resouces of concern to the Service. Trends and outlook for energy developments are discussed for power generation, oil and gas production, refineries, transportation, strategic petroleum reserve, liquefied natural gas, geothermal, and synthetic fuels. GRA

N81-32738# National Oceanic and Atmospheric Administration, Washington, D. C.
ACID PRECIPITATION
Feb. 1981 16 p refs
(PB81-202673; CIO-81-1; NOAA-81040201) Avail: NTIS HC A02/MF A01 CSCL 04A

A comprehensive 10 year acid precipitation research plan to study environmental and atmospheric effects and to monitor precipitation acidity is described. Current issues relate to: the establishment of networks and standards for long term monitoring and measurement of acid precipitation; the promotion of research on the environmental effects of acid precipitation; and the assessment of the financial costs of acid precipitation and the economic benefits of acid precipitation control programs, weighed with other pollution control programs and the national need for increased coal utilization. GRA

N81-32740# Council for Scientific and Industrial Research, Pretoria (South Africa).
INTERNATIONAL CONFERENCE ON AIR POLLUTION, VOLUME 2
Oct. 1979 308 p refs In ENGLISH and AFRIKAANS Conf. held in Pretoria, 22-25 Oct. 1979 4 Vol.
(PB81-205064) Avail: NTIS HC A14/MF A01 CSCL 13B

Papers on methods of reducing air pollution in the metallurgical and chemical industries and in power generation plants are presented. The prevention of dust emissions, fluidized bed combustion for pollution control, processing of smelter off gasses, reduction of pollution from steel plants, and related energy considerations are discussed. GRA

N81-32741# Council for Scientific and Industrial Research, Pretoria (South Africa).
INTERNATIONAL CONFERENCE ON AIR POLLUTION, VOLUME 3
Oct. 1979 382 p refs In ENGLISH and AFRIKAANS Conf. held in Pretoria, 22-25 Oct. 1979 4 Vol.
(PB81-205072) Avail: NTIS HC A17/MF A01 CSCL 13B

Methods of measuring air pollution, modeling pollution transport, and energy conservation and waste utilization for energy production are discussed. GRA

N81-32745# Aerospace Corp., Los Angeles, Calif. Energy and Resources Div.
DISPOSAL OF FLUE GAS DESULFURIZATION WASTES: EPA SHAWNEE FIELD EVALUATION Final Report, Sep. 1974 - Sep. 1980
P. R. Hurt, P. P. Leo, J. Rossoff, and J. R. Witz Jun. 1981 289 p refs
(Contract EPA-68-02-2633)
(PB81-212482; EPA-600/7-81-103; IERL-RTP-1199) Avail: NTIS HC A13/MF A01 CSCL 13B

Methods and costs for disposing of wastes produced from wet non-regenerable scrubbing of SO2 from coal-fired utility-boiler flue gases were evaluated. The environmental effects of various disposal techniques were studied, including evaluations of untreated, chemically treated, and oxidized wastes utilizing lime or limestone scrubber absorbents. Because water quality and land reclamation are to principal interest, leachate, supernate, runoff, and ground water were analyzed, and physical properties of the wastes were evaluated. No measurable effect on ground water quality at the disposal site was detected during the program. Chemical treatment and underdrainage of untreated waste yielded structurally sound materials. GRA

N81-32816# Tompkins (Daryl), Friendly, Md.
WIND ENERGY IN MARYLAND
Daryl Tompkins Jul. 1980 37 p refs Sponsored by Dept. of National Resources, Annapolis, Md.
(PB81-199937; PPSP/PPRP-41) Avail: NTIS HC A03/MF A01 CSCL 10A

This report marks one of the first steps in defining the wind energy option in Maryland. In the following sections, the state of the art is reviewed, applications, economic, and environmental issues were introduced, the results of a preliminary wind energy resource assessment completed in April of 1979 are discussed, and recommendations are made for further resource definition. GRA

N81-32956*# California Univ., Los Angeles School of Engineering and Applied Science
FORECAST OF FUTURE AVIATION FUELS: THE MODEL Final Report
M. B Ayati, C. Y. Liu, and J. M. English Sep. 1981 192 p refs
(Contract NsG-3116)
(NASA-CR-165486; UCLA-eng-8037) Avail: NTIS HC A09/MF A01 CSCL 12B

A conceptual models of the commercial air transportation industry is developed which can be used to predict trends in economics, demand, and consumption. The methodology is based on digraph theory, which considers the interaction of variables and propagation of changes. Air transportation economics are treated by examination of major variables, their relationships, historic trends, and calculation of regression coefficients. A description of the modeling technique and a compilation of historic airline industry statistics used to determine interaction coefficients are included. Results of model validations show negligible difference between actual and projected values over the twenty-eight year period of 1959 to 1976. A limited application of the method presents forecasts of air transportation industry demand, growth, revenue, costs, and fuel consumption to 2020 for two scenarios of future economic growth and energy consumption. Author

N81-33098# Committee on Science and Technology (U. S. House).
HELIUM: ENERGY ACT OF 1980
Washington GPO 1981 387 p refs Hearing on H. R. 7336 before the Subcomm. on Energy Res. and Production, the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., No. 170, 17 Jun. 1980 (GPO-71-077) Avail: Subcommittee on Energy Research and Production

Legislation developing a helium gas conservation program is discussed. A national helium reserve of 85 billion cu ft by 1990 is sought. The Secretary of Energy is required to acquire and store helium offered for purchase, bearing all transportation and storage costs. Taxes are removed, and royalty assessment of helium gas is delayed until it is repurchased. The Government is granted the power of eminent domain to acquire helium and to operate helium extraction facilities. The Government is required to buy the helium it uses from the private market. The sale of federally owned helium is permitted only when the cost approaches the cost of extracting helium from the air. J.D.H.

N81-33102# Transportation Research Board, Washington, D.C.
URBAN SYSTEMS AND TRAFFIC EVALUATIONS
William H. Dietrich, Michael A. Kennedy, Jon Twichell, Janis M. Gross, Peter M. Lima, Yacov Zahavi, Gabriel Roth, William D. Glauz, D. J. Migletz, and J. S. Ludwick, Jr. 1980 43 p refs (PB81-204679; TRB/TRR-770; ISBN-0-309-03114-1; ISSN-0361-1981) Avail: NTIS HC A03/MF A01 CSCL 13B

Contents include: a joint institutional tranportation systems management program; Forecasting energy impacts of TSM actions; an evaluation of transportation system management strategies; and measuring the effectiveness of priority schemes for high-occupancy vehicles. Traffic conflicts techniques for use at intersections are discussed. Comparison of three loran position-determination techniques in the Los Angeles area are presented. GRA

N81-33158*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ANALYSIS OF THE PERFORMANCE OF THE DRIVE SYSTEM AND DIFFUSER OF THE LANGLEY UNITARY PLAN WIND TUNNEL

Robert L. Stallings and Lowell E. Hasel Oct. 1981 67 p refs (NASA-TM-83168; L-14643) Avail: NTIS HC A04/MF A01 CSCL 01A

A broad program was initiated at the Langley Research Center in 1973 to reduce the energy consumption of the laboratory. As a part of this program, the performance characteristics of the Unitary Plan Wind Tunnel were reexamined to determine if potential methods for increasing the operating efficiencies of the tunnel could be formulated. The results of that study are summarized. The performance characteristics of the drive system components and the variable-geometry diffuser system of the tunnel are documented and analyzed. Several potential methods for reducing the energy requirements of the facility are discussed. T.M.

N81-33184# Federal Aviation Administration, Washington, D.C. Air Traffic Service

OPERATION FREE FLIGHT: AN OPERATIONAL EVALUATION OF DIRECT ROUTE FLIGHT PLAN FILING IN TODAY'S NATIONAL AEROSPACE SYSTEM Final Report

Wayne Minnick Jul. 1981 87 p

(AD-A104150; FAA-AT-81-1) Avail: NTIS HC A05/MF A01 CSCL 17/7

This report presents the results of an operational evaluation concerning the feasibility of permitting the filing of direct route flight plans, without route definition, between departure and arrival area fixes serving selected city-pairs. The evaluation was conducted with the voluntary participation of Eastern, United, and Pan American Airlines during the period June 1 through December 31, 1980. Objectives of Operation Free Flight were to obtain factual information about air traffic control (ATC) handling of test aircraft on direct routings, system prohibitions to the concept, general pilot attitude regarding the utility of their RNAV equipment, potential fuel savings, and ATC system impact. The evaluation was conducted throughout the contiguous United States between 27 city-pairs. The primary conclusions were: the operational concept of filing direct, great circle routes between departure and arrival area fixes, at altitudes above Flight Level 290, in a radar environment; incompatibility with traffic arrival flow at destination airports was determined to be the most significant system prohibition; pilot attitude was skewed in a positive direction; potential fuel savings are projected to be in excess of 40,000,000 gallons per year, and, there was no adverse impact to the ATC system. Author (GRA)

N81-33201# Peat, Marwick, Mitchell and Co., San Francisco, Calif.

RESPONSES TO COMMENTS OF AIR TRANSPORT ASSOCIATION OF AMERICA ON AIRCRAFT TOWING FEASIBILITY STUDY

Jun. 1981 112 p refs

(Contract DE-AC01-79CS-50069)

(DE81-029834; DOE/CS-50069/T1) Avail: NTIS HC A06/MF A01

A preliminary assessment of the constraints on and feasibility of extended aircraft towing between airport runways and terminal gate areas with engines shutdown is made. Past aircraft towing experience and the state of the art in towing equipment are reviewed. Safety and operational concerns associated with aircraft towing are identified, and the benefits and costs of implementing aircraft towing at 20 major US airports are analyzed. It was concluded that extended aircraft towing is technically feasible and that substantial reductions in aircraft fuel consumption and air pollutant emissions can be achieved through its implementation. It was also concluded that, although capital and operating costs associated with towing would be increased, net savings could generally be attained at these airports. Because of the lack of past experience and the necessity of proving the cost effectiveness of towing concept, a demonstration of the feasibility of large scale aircraft towing is necessary. DOE

N81-33316# Oak Ridge National Lab., Tenn.

IMPACT OF ENVIRONMENTAL CONTROL COSTS ON AN INDIRECT COAL LIQUEFACTION

P. J. Johnson, R. M. Wham, S. P. N. Singh, and J. F. Fisher Aug. 1981 218 p refs

(Contract W-7405-eng-26)

(DE81-026541; ORNL-5722) Avail: NTIS HC A10/MF A01

The effect on product price of three different scenarios for the control of emissions to the environment by a conceptual, commercial indirect coal liquefaction facility is examined. The plant design utilizes Lurgi dry-ash gasifiers operating on western, subbituminous coal to provide synthesis gas for low pressure methanol synthesis and subsequent conversion of the methanol to gasoline. Levels of emission control, which are based as much as possible on existing regulations for analogous processes, range from minimal control to more stringent control than that currently in effect. The use of several emission control options and the reduction of plant size are also examined in regard to their effects on product price. Environmental control to current levels would account for 12% of the product price for the facility assumed here. More stringent emission standards would produce an additional price. Two unpredictable factors having the greatest impacts on product price, however, are inflation and the method of financing. DOE

N81-33332# Stuttgart Univ. (West Germany).

SAAR: TRANSPORT SYSTEM FOR DISTRICT HEATING [FERNWAERMESCHIENE SAAR]

W. Hochreuther (Saarberg-Fernwaerme GmbH., Saarbruecken, West Germany) *In its* Commemoration of 60th Anniv. of Professor Dr. Jakob Wachter Jan. 1980 p 221-250 In GERMAN

Avail: NTIS HC A16/MF A01

The Saar transport system for the utilization of waste heat from power stations and industrial processes for district heating is discussed. Construction of a regional compound system for district heating was demonstrated in the Voelkingen district. Author (ESA)

N81-33489# Energy and Environmental Analysis, Inc., Arlington, Va.

HEAVY-DUTY ENGINES ANALYSIS, STUDY 2: ANALYSIS OF EMISSION REGULATIONS AND TEST PROCEDURES FOR THE GAS TURBINE ENGINE

K. G. Duleep Jun. 1981 117 p refs Prepared for Argonne National Lab.

(Contract W-31-109-eng-38)

(DE81-029990; ANL/CNSV-TM-74) Avail: NTIS HC A06/MF A01

There is considerable interest in heavy duty gas turbines (HDGT) suitable for use in trucks and buses because of their potential for reduced maintenance, improved fuel economy, better overall reliability, and cleaner exhaust emissions relative to existing (gasoline and diesel) heavy duty engines. This analysis focuses on the application of current and expected emissions measurement techniques to heavy duty gas turbines. The purposes of this report are to: identify emission requirements for heavy duty engines applicable during and after completion of the DOE demonstration program, i.e., 1985; provide an understanding of current steady state test procedures and applicability to the HDGT; describe the development and methodology of the test procedures and sampling techniques to measuring emissions from the HDGT; and assess the limitations and problems of current sampling techniques for regulated pollutants and identify promising methods of sampling that are applicable to the HDGT. This information should serve as a comprehensive guide to emissions testing requirements and test procedures for the HDGT. DOE

N81-33538 International Institute for Applied Systems Analysis, Laxenburg (Austria).

[SYSTEMS ANALYSIS AND WORLD RESOURCES] Annual Report, 1980

H. J. Miser, ed. and D. Delves, ed. 1981 87 p refs

Avail: Issuing Activity

Research on energy systems and on food and agriculture programs is outlined. Progress in the resources and environment, human settlements and services, management and technology, system and decision sciences, general research, and education areas was reviewed. The conclusions of a seven year study of the global energy problem are presented. Optimization research, including large scale structured linear programming and stochastic optimization was conducted. Global and regional economic modelling efforts are described. Author (ESA)

N81-33576*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

REPORT OF ACTIVITIES OF THE ADVANCED COAL EXTRACTION SYSTEMS DEFINITION PROJECT, 1979 - 1980

Milton L. Lavin and Lionel Isenberg 1 Aug. 1981 222 p refs
(Contract NAS7-100; Contract DE-AI01-76ET-12548)
(NASA-CR-164852; JPL-Pub-81-69; DOE/ET-12548/7) Avail: NTIS HC A10/MF A01 CSCL 08I

During this period effort was devoted to: formulation of system performance goals in the areas of production cost, miner safety, miner health, environmental impact, and coal conservation, survey and in depth assessment of promising technology, and characterization of potential resource targets. Primary system performance goals are to achieve a return on incremental investment of 150% of the value required for a low risk capital improvement project and to reduce deaths and disability injuires per million man-hour by 50%. Although these performance goals were developed to be immediately applicable to the Central Appalachian coal resources, they were also designed to be readily adaptable to other coals by appending a geological description of the new resource. The work done on technology assessment was concerned with the performance of the slurry haulage system. T.M.

N81-33622# Midwest Research Inst., Golden, Colo. Planning, Applications, and Impacts Div.

ENVIRONMENTAL, HEALTH, SAFETY, AND REGULATORY REVIEW OF SELECTED PHOTOVOLTAIC OPTIONS: COPPER SULFIDE/CADMIUM SULFIDE AND POLYCRYSTALLINE SILICON

Kathryn Lawrence, Sue Morgan, David Schaller, and Thomas Wilczak Jun. 1981 240 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-027294; SERI/TR-743-799) Avail: NTIS HC A11/MF A01

Emissions, effluents and solid wastes from the fabrication of both polycrystalline silicon and front-wall copper sulfide/cadmium sulfide photovoltaic cells are summarized. Environmental, health, and safety characteristics of cell fabrication material inputs and by products are listed. Candidate waste stream treatment methods and resultant effluents are reviewed. Environmental, health, and safety effects of photovoltaic cell/module/array installation, operation, maintenance, and decommission are summarized. Federal legislation is addressed and future regulatory trends under these laws as they may affect each cell process are discussed. Water quality, solid waste disposal, and occupational health and safety regulations will likely be those most applicable to commercial scale PV production. Currently available control technology appears sufficient to treat cell fabrication wastes. DOE

N81-33632# Hittman Associates, Inc., Columbia, Md.

EVALUATION OF HYBRID SOLAR/FOSSIL RANKINE-COOLING CONCEPT

H. M. Curran Nov. 1980 29 p refs
(Contract DE-AC03-79CS-30202)
(DOE/CS-30202/T3; H-C1007/010-80-990) Avail: NTIS HC A03/MF A01

The hybrid solar/fossil Rankine cycle is analyzed thermodynamically to determine fuel use and efficiency. The hybrid system is briefly compared with solar organic Rankine systems with a fossil fuel auxiliary mode, and with geothermal resources. The economic evaluation compares the present value of the superheater fuel cost over the system lifetime with the first cost reduction obtained by substituting a hybrid solar/fossil Rankine engine. The economics analysis indicates that even if the hybrid solar/fossil Rankine cooling system were developed to the point of being a commercial product with an economic advantage over an otherwise equivalent solar organic Rankine cooling system, it would gradually lose that advantage with rising fuel costs and decreasing collector costs. From the standpoint of national fossil fuel conservation, the hybrid concept would be preferable only in applications where the operating duration in the solar/fossil mode would be substantially greater than in the fossil fuel only auxiliary mode. DOE

N81-33669# Illinois Inst. of Natural Resources, Springfield.

ILLINOIS RESIDENTIAL ENERGY EFFICIENCY INDEX

Walter Zyznieuski Jan. 1981 28 p refs
(Contract DE-F646-80CS-69095)
(PB81-211021; ILLDOE-81S/02) Avail: NTIS HC A03/MF A01 CSCL 10A

The index (EEI) measures the amount of natural gas and electricity used for heating in Illinois homes during a four year period (1976-1980). The four year EEI results based on data received from the utilities involved in the study were reviewed. GRA

N81-33670# Illinois Inst. of Natural Resources, Springfield.

ILLINOIS ENERGY PLAN: STAFF WORKING PAPER. VOLUME 1: ILLINOIS ENERGY CONSUMPTION TRENDS, 1960-2000

May 1981 297 p refs
(PB81-211245; ILLDOE-81S/13-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 10A

An analysis of historical state energy consumption patterns for five different economic sectors: residential, transportation, commercial, agricultural and industrial is presented. Future energy consumption and costs in Illinois are projected. GRA

N81-33671# Charles River Associates, Inc., Boston, Mass.

ENERGY REQUIREMENTS FOR METALS PRODUCTION: COMPARISON BETWEEN OCEAN NODULES AND LAND-BASED RESOURCES Final Report

Sep. 1980 100 p refs
(PB81-211351; NOAA-81040602; CRA-492) Avail: NTIS HC A05/MF A01 CSCL 10A

The energy requirements for production of copper, nickel, cobalt, and manganese from ocean nodules are based on an ocean mining operation of 3 million tons per year of dry nodules. A linear relationship exists between the amount of nodules processed and the total energy so that the energy can be easily converted to other processing rates if desired. GRA

N81-33676# National Bureau of Standards, Washington, D.C. Building Equipment Div.

CONTROL STRATEGIES FOR ENERGY CONSERVATION. A CASE STUDY OF THE MATERIALS BUILDING, NATIONAL BUREAU OF STANDARDS Final Report

James Y. Kao and E. Thomas Pierce Jun. 1981 48 p refs
(PB81-217804; NBSIR-81-2277) Avail: NTIS HC A03/MF A01 CSCL 13A

The BLAST-2 computer program was used to investigate various heating, ventilating and air conditioning control strategies and their combinations to reduce the energy consumption of a laboratory building. The techniques of modeling the building load and air system performance are explained. The results are presented and discussed. Control strategies investigated include dry-bulb and enthalpy economizer cycles, resetting supply air tempratures by outside temperature and zone demand, shutdown of fan systems selectively, and converting interior systems to VAV systems. By combining the various control strategies, eight percent, twenty-nine percent and eight percent of heating, cooling and fan energy respectively may be saved. GRA

N81-33677# National Bureau of Standards, Washington, D.C.

RESEARCH AND INNOVATION IN THE BUILDING REGULATORY PROCESS: PROCEEDINGS OF THE 5TH ANNUAL NBS/NCSBCS JOINT CONFERENCE. TECHNICAL SEMINAR ON SOLAR ENERGY CONSERVATION Final Report

Sandra A. Berry May 1981 211 p refs Proc. held at Denver, 6 Aug. 1980
(PB81-219321; NBS/SP-608) Avail: NTIS HC A10/MF A01 CSCL 13A

Topics in solar energy and energy conservation are addressed. These proceedings include: (1) energy programs in the state of Colorado; (2) building energy performance standards concepts (3) state energy audits; (4) energy and building systems services; (5) solar energy and building codes. GRA

N81-33680# Battelle Pacific Northwest Labs., Richland, Wash.

EVALUATION OF FLYASH SURFACE PHENOMENA AND THE APPLICATION OF SURFACE ANALYSIS TECHNOLOGY, PHASE 1 Summary Report

R. D. Smith Jun. 1981 66 p refs
(Contract DE-AC06-76RL-01830)
(DE81-029106; PNL-3842) Avail: NTIS HC A04/MF A01

The factors governing the formation of flyash surfaces during and following coal combustion were reviewed. The competing chemical and physical processes during the evolution of inorganic material in coal during combustion into flyash are described with respect to various surface segregation processes. Two mechanisms leading to surface enrichment are volatilization-condensation

processes and diffusion processes within individual flyash particles. The experimental evidence for each of these processes was reviewed. It is shown that the volatilization-condensation process is the major factor leading to trace element enrichment in smaller flyash particles. DOE

N81-33681# Department of Energy, Washington, D. C.
ENVIRONMENTAL TRENDS TO THE YEAR 2000
Jul. 1981 23 p refs
(DE81-027695; DOE/EP-0021) Avail: NTIS HC A02/MF A01

This analysis focuses on the environmental impacts of the National Energy Policy Plan and emphasizes those pollutants for which energy development and use play a significant role. The increase in relative contributions of the energy sector to emissions during the study period is within a range of zero to 15% for all selected pollutants with the exception of ash, captured particulates, and oil-shale waste. For the group, the energy sector contribution increases from 58% to 89%, primarily because of the production of oil from shale. If the oil-shale wastes were not included in these totals, energy-process wastes would be 62% of the national total of 250 million tons. Even though these figures represent total net emissions to the environment, rather than ambient concentrations, the assessment offers a sound basis for an important overall conclusion. The significant economic growth projected by the National Energy Policy Plan, and continuing free-market efforts to ensure the wise and efficient application of energy resources by the nation, can be achieved without foresaking reasonable environmental quality. DOE

N81-33686# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.
ADVANCED PULVERIZED-COAL COMBUSTOR FOR CONTROL OF NO/SUB X/ EMISSIONS Quarterly Report, 1 Apr. - 30 Jun. 1981
R. L. Pam, S. T. Suttmann, J. T. Kelly, and E. K. Chu 31 Jul. 1981 20 p
(Contract DE-AC22-80PC-30296)
(DE81-029124; DOE/PC-30296/T1; QR-3) Avail: NTIS HC A02/MF A01

A dimensional combustor, incorporating fuel staging for control of NO/sub x emissions was examined. A comprehensive computer model is developed to allow NO mechanisms and rates to be extracted from the experimental data. Initial PROF code runs led to extensive debugging efforts. A simplified radiation model formulation and devolatization model are described. Combustor installation was completed. Work utilizing fuel staging concepts is summarized in terms of its NO/sub x/ reduction potential. DOE

N81-33687# Ames Lab., Iowa.
ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF POWER PLANT FLY ASH
M. J. Murtha 1980 17 p refs Presented at 3rd Miami Intern. Conf. on Alternative Energy Sources, Bal Harbour, Fla., 15-17 Dec. 1980
(Contract W-7405-eng-82)
(DE81-023777; IS-M-309; CONF-801210-28) Avail: NTIS HC A02/MF A01

The environmental impact of coal combustion and fly ash disposal, the current status of relevant legislation and regulations, and ash utilization process development are discussed. A process being developed for metals recovery from fly ash is described. DOE

N81-33703# Gilbert Associates, Inc., Reading, Pa.
COMPATIBILITY OF SOURCE SEPARATION AND MIXED-WASTE PROCESSING FOR RESOURCE RECOVERY Final Report
M. G. Klett, W. H. Fischer, B. N. Murthy, H. H. Fiedler, L. M. Oliva (Resource Planning Associates, Washington, D. C.), and R. Crystal (Crystal Planning and Commun., Inc.) Jun. 1981 194 p refs
(Contract EPA-68-02-2645)
(PB81-216046; EPA-600/2-81-097) Avail: NTIS HC A09/MF A01 CSCL 13B

Existing source separation programs and mixed-waste processing facilities were analyzed four broad areas of concern, energy and materials conservation, environmental impacts institutional and technological impacts, and economic impacts are considered. Issues most important for each viewpoint are assessed for each combination of options and alternatives. The issues addressed are: changes in production of useful energy from a mixed waste processing facility, air, land, and water pollution emissions, contractors employment, operator profitability, total solid waste collection costs, and quantities of recycled materials. GRA

N81-33704# GCA Corp., Bedford, Mass. Technology Div.
ENVIRONMENTAL ASPECTS OF FLUIDIZED-BED COMBUSTION Final Report
J. M. Robinson, R. J. Kindya, C. W. Young, R. R. Hall, and P. Fennelly Apr. 1981 80 p refs
(Contract EPA-68-02-2693)
(PB81-217630; GCA-TR-80-108-G; EPA-600/7-81-075) Avail: NTIS HC A05/MF A01 CSCL 13B

Emissions data indicate that FBC technology is a viable alternative to conventional coal combustion. Adverse impacts on health or the environment appear to be minimal; at worst, they are no different than for conventional coal combustion systems. To support this conclusion, specific results of FBC sampling and analysis from work performed through late 1979 are discussed. GRA

N81-33705# Research Triangle Inst., Research Triangle Park, N. C.
EVALUATION OF RELATIVE ENVIRONMENTAL HAZARDS FROM A COAL GASIFIER Final Report, Nov. 1976 - Apr. 1981
S. K. Gangwal, J. G. Cleland, and R. S. Truesdale Jun. 1981 108 p refs
(Grant EPA-R-804979)
(PB81-217648; EPA-600/7-81-100; RTI/1934/00-02F) Avail: NTIS HC A06/MF A01 CSCL 13B

Environmental hazards from a laboratory scale coal gasifier were evaluated. Relative environmental hazards were determined by the multimedia environmental goals methodology. Toxicity and mutagenicity were assessed. It is found that environmentally, the most significant effluent stream is aqueous condensate, followed by tar, product gas, and ash. However, on an equivalent weight basis, the tar stream is more toxic and mutagenic than aqueous condensate. Polycyclic aromatic hydrocarbons and organic bases are the most mutagenic fractions of the tar. Coal pyrolysis and gasificaion at higher tempratures leads to reduced tar mutagenicity. GRA

N81-34100# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
THE ELECTRIC VEHICLE ALTERNATIVE M.S. Thesis
David E. Swanson and Michael R. VanHouse Jun. 1981 145 p refs
(AD-A103810; AFIT-LSSR-35-81) Avail: NTIS HC A07/MF A01 CSCL 13/6

This thesis discusses three basic concepts of economic analysis: the time value of money, life cycle cost, and reliability theory. Using these concepts, a method of economic analysis is developed to be used in evaluating the possible replacement of internal combustion engine (ICE) vehicles with electric vehicles (EVs). This methodology is then demonstrated by comparing two possible alternatives for replacement of the existing fleet of pickup trucks assigned to the 4950th Test Wing Aircraft Maintenance Complex at Wright-Patterson AFB, Ohio. One alternative is to replace the existing pickup fleet with new ICE pickups, the other is to replace the existing fleet with EVs. In this research effort the ICE pickup fleet is found to be the low cost alternative. Recommendations for further research and additional considerations are provided to the reader. This thesis contains an extensive bibliography on EV technology and principles of economic analysis. Author (GRA)

N81-34102# Argonne National Lab., Ill.
PROJECTION OF US TRANSPORTATION NEEDS FOR BEYOND 1990: A MARKET FOR ADVANCED VEHICLES?
Martin J. Bernard, III 8 Dec. 1980 18 p refs Presentad at the Elec. and Hybrid Vehicle Advan. Technol. Seminar, Pasadena, Calif., 8 Dec. 1980
(Contract W-31-109-eng-38)
(DE81-023820; CONF-801242-7) Avail: NTIS HC A02/MF A01

Forecasts of the advanced vehicle (AV) market to the year 2000 are made considering petroleum supplies, electric power demand, economics, and environmental impacts. It is concluded

that there are markets for AVs, but the competition in the market place from other technologies will be substantial. Utilities should have sufficient capacity for two or more decades to handle offpeak charging of electric hybrid vehicles but acid rain from coal power plant emissions will remain a major environmental problem, which can only raise the cost of electricity and thus AV operation. All this will tax the creativity of the AV innovator DOE

02

SOLAR ENERGY

Includes solar collectors, solar cells, solar heating and cooling systems, and solar generators.

A81-41221 Surface recombination effects on the performance of n/+/p step and diffused junction silicon solar cells. J. D. Arora, P. C. Mathur (Delhi, University, Delhi, India), and S. N. Singh (Delhi, University, Delhi; National Physical Laboratory of India, New Delhi, India). *Solid State Electronics*, vol. 24, Aug. 1981, p. 739-747. 18 refs.

A81-41223 Solar cell fill factors - General graph and empirical expressions. M. A. Green (New South Wales, University, Kensington, Australia). *Solid State Electronics*, vol. 24, Aug. 1981, p. 788, 789. Research supported by the Australian Research Grants Committee.

Two techniques for evaluating solar cell fill factors (FF) are discussed. One is a graph which allows FF to be determined for any combination of parameters used to characterize cell performance, while the second consists of empirical expressions by which FF under similar general conditions can be described. Results confirm that a high degree of accuracy can be obtained by the two techniques, showing 0.54 for the graph, and 0.547 using the empirical expressions, as compared to the exact value of 0.556. E.B.

A81-41332 Photovoltaic solar arrays - Unlimited power for our space vehicles. L. G. Chidester (Lockheed Missiles and Space Co., Inc., Space Systems Div., Sunnyvale, CA). *Lockheed Horizons*, Summer 1981. p. 2-10.

Solar cell technology is reviewed with reference to the high-efficiency cells, ultra-thin cells, GaAs cells and wrap-around cells. Performance characteristics are presented noting the advantages of GaAs cells over silicon cells. A number of solar array configurations are illustrated including large flexible arrays and curved graphite panels. Attention is given to the NASA Solar Electric Propulsion Stage program which would use ion engines to propel spacecraft in interplanetary missions. Applications of solar cell technology to the Space Shuttle program are discussed, including the Power Extension Package, lightweight arrays and solar energy concentrators. S.C.S.

A81-41692 * A solar simulator-pumped atomic iodine laser. J. H. Lee (Vanderbilt University, Nashville, TN) and W. R. Weaver (NASA, Langley Research Center, Hampton, VA). *Applied Physics Letters*, vol. 39, July 15, 1981, p. 137-139. 9 refs. Grant No. NCC1-8.

An atomic iodine laser, a candidate for the direct solar-pumped gas laser, was excited with a 4-kW beam from a xenon arc solar simulator. Continuous lasing at 1.315 micron for over 10 ms was obtained for static filling of n-C3F7I vapor. By momentarily flowing the lasant, a 30-Hz pulsed output was obtained for about 200 ms. The peak laser power observed was 4 W for which the system efficiency reached 0.1%. These results indicate that direct solar pumping of a gas laser for power conversion in space is indeed feasible. (Author)

A81-41801 Reflector satellites for solar power. T. F. Rogers. *IEEE Spectrum*, vol. 18, July 1981, p. 38-43. 9 refs.

A global photovoltaic power distribution system is conceptualized in the paper. GW sized solar cell arrays constructed in sunny, arid regions of the world would convert sunlight to dc, dc to microwaves in mm length, then beam the power to passively reflecting geostationary satellites, which in turn redirect the beams to rectennas on the earth for reconversion to dc for immediate use or adjustment to ac and transmission. The system is projected to have lower costs for space equipment than SPS because the cells would be based earth-side, and could be constructed in areas where the populations are poorest and land is least valuable. Cost estimates are in the range of $20 billion for 10,000 sq km collectors and converters and a 600 sq mm reflector in orbit. A global distribution of the photovoltaic clusters would provide base-load electricity because some areas would always be in sunlight. Techniques for compensation for atmospheric attenuation are reviewed, noting a final system efficiency of 1-8% is attainable, with costs similar to those now associated with fusion power development. D.H.K.

A81-41824 Factors influencing solar energy collector efficiency. P. K. C. Pillai and R. C. Agarwal (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 8, July 1981, p. 205-213. 7 refs.

The effects of glazing, solar flux, emissivity and absorptivity of the absorber surface on collector performance have been predicted for different plate temperatures (60 C and 100 C). At low solar flux levels (200-600 W/sq m) double- or triple-glazed collectors are superior to single-glazed collectors. For collectors with selective absorber coatings, the optimal number of glazing planes is two. Higher values of absorptivity and lower values of emissivity are more effective for single-glazed than for double-glazed collectors. (Author)

A81-41970 Solar thermal engineering: Space heating and hot water systems. P. J. Lunde (Hartford Graduate Center, Hartford, CT). New York, John Wiley and Sons, Inc., 1980. 635 p. 108 refs. $30.

Heat transfer fundamentals are considered along with solar radiation, flat plate collectors, optically concentrating collectors and reflectors, the transfer of the collected heat, the storage of the collected heat, long-term system performance, parametric studies, economic evaluation, solar systems design, passive heating systems, solar radiation tables, and solar radiation data on inclined surfaces for selected U.S. locations for use with the base-temperature methods for performance prediction. Attention is given to the thermal characteristics of buildings, collector plate surfaces, collector performance, collector improvement, the effect of incident angle, heat transfer to fluids, freeze protection, heat exchanger analysis, the heat exchanger factor, stratified storage, well-mixed storage, annual heat storage, fundamentals of economic analysis, system optimizations, swimming pool heaters, hot water heating, pumps and fans, and sizing pipe and ductwork. G.R.

A81-42150 New ion implant technique for low-cost solar cell fabrication. K. Tokiguchi, H. Itoh, N. Sakudo, H. Koike, I. Kanomata, and T. Tokuyama (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, Japan). *Review of Scientific Instruments*, vol. 52, July 1981, p. 1110, 1111. Research supported by the Ministry of International Trade and Industry.

A new implant technique, in which a single magnet carries out mass separation and ion beam scanning, is described. Dose uniformity and energy conversion efficiency of a solar cell fabricated using this technique are investigated. (Author)

A81-42451 * Dispersed solar thermal generation employing parabolic dish-electric transport with field modulated generator systems. R. Ramakumar (Oklahoma State University, Stillwater, OK) and K. Bahrami (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Solar Energy*, vol. 27, no. 1, 1981, p. 7-11. 6 refs. Research sponsored by the U.S. Department of Energy and NASA.

This paper discusses the application of field modulated generator systems (FMGS) to dispersed solar-thermal-electric generation from a parabolic dish field with electric transport. Each solar generation unit is rated at 15 kWe and the power generated by an array of such units is electrically collected for insertion into an existing utility grid. Such an approach appears to be most suitable when the heat engine rotational speeds are high (greater than 6000 r/min) and, in particular, if they are operated in the variable speed mode and if utility-grade a.c. is required for direct insertion into the grid without an intermediate electric energy storage and reconversion system. Predictions of overall efficiencies based on conservative efficiency figures for the FMGS are in the range of 25 per cent and should be encouraging to those involved in the development of cost-effective dispersed solar thermal power systems. (Author)

A81-42452 **A fixed Fresnel lens with tracking collector.** E. M. Kritchman, A. A. Friesem, and G. Yekutieli (Weizmann Institute of Science, Rehovot, Israel). *Solar Energy*, vol. 27, no. 1, 1981, p. 13-17. 20 refs.

The application of a wide angle concentrating Fresnel lens to a linear solar energy system, in which the optical concentration is stationary while the absorber follows the locus of best foci, is investigated. The two substantial direction possibilities of the linear axis, east-west and polar, are compared to each other. It is shown that such a concentrator may operate about six hours a day throughout the year with an average effective concentration exceeding 10. Specifically, a polar installation, including a fixed lens and a fixed assembly of separate absorbers behind it, may enable sufficient concentration for residential heating and airconditioning without any moving parts. (Author)

A81-42453 **Thermal analysis of CPC collectors.** C. K. Hsieh (Florida, University, Gainesville, FL). *Solar Energy*, vol. 27, no. 1, 1981, p. 19-29. 36 refs. Contract No. W-31-109-eng-38.

Mathematical formulations were developed to study thermal processes in a compound-parabolic-concentrator (CPC) collector. The system under investigation consists of a CPC cusp fitted with a concentric, evacuated double pipe to serve as a heat absorber. Heat is transmitted to the circulating fluid flowing inside a U-tube via the heat getter slipped inside the inner pipe. The collector has a cover for dust protection. Four nonlinear, simultaneous equations were derived to predict heat exchange among various components in the system. Collector efficiency equations were also developed following the Hottel-Whillier-Woertz-Bliss formalism. These equations were subsequently used in a computer program to test the collector performance under varied operating conditions. Test results indicate that, because of the high thermal resistance between the receiver jacket and the envelope, the collector performance is quite stable and is nearly independent of many parameters tested. The efficiency of the collector is high and shows only a very slight drop at high operating temperatures. The predicted results were also compared with experiments. (Author)

A81-42454 **Numerical evaluation of radiation absorption by a fluid confined in a semi-transparent circular cylinder.** M. Sokolov and C. Saltiel (Tel Aviv University, Tel Aviv, Israel). *Solar Energy*, vol. 27, no. 1, 1981, p. 31-35. 6 refs.

Solar energy absorbed by a fluid contained in a circular cylindrical vessel is calculated with consideration given to energy losses due to reflection and energy absorption of the cover. A computer simulated specular radiation for various cover thicknesses, coefficients of extinction, and cover diameters and concentrations, including all ray cascades. A comparison was made of the energy absorbed, for circular and flat geometries. Also obtained was an optimum fluid diameter for a given cover thickness with respect to the amount of energy absorbed by the fluid per unit aperture. D.L.G.

A81-42455 **Calculation of the top loss coefficient of a flat-plate collector.** V. K. Agarwal and D. C. Larson (Drexel University, Philadelphia, PA). *Solar Energy*, vol. 27, 1981, p. 69-71. 7 refs.

The useful energy gain of a flat plate collector depends strongly on energy losses due to convective and radiative heat transfer processes from the top surface of the collector. Klein's (1975) empirical equations are given, discussed, and compared at different plate temperatures for calculations of a simpler equation for a top loss coefficient. Results show Klein's approach as satisfactory, although discrepancies arose when testing for the coefficient's dependence on collector tilt. In addition, the new equation proved simpler to manipulate, and provided an enhanced accuracy in the calculations over a wide range of different parameters. D.L.G.

A81-42458 **Enhanced air flow over cooling fins in solar energy convertors.** J. W. Cochrane and H. J. Goldsmid (New South Wales, University, Kensington, Australia). *Solar Energy*, vol. 27, no. 1, 1981, p. 89, 90. Research supported by the National Energy Research, Development and Demonstration Council of Australia.

A81-42489 **The physics of heavily doped n/+/-p junction solar cells.** H. P. D. Lanyon (Solar Energy Research Institute, Golden, CO; Worcester Polytechnic Institute, Worcester, MA). *Solar Cells*, vol. 3, July 1981, p. 289-311. 18 refs.

Current-voltage characteristics of a p-n junction in terms of the diffusion of minority carriers in the neutral regions on either side of the junction space charge region were first considered by Shockley (1949). Early in the 1970s it became obvious that large deviations from this theory were occurring in solar cells which had a heavily doped emitter region on low-resistivity base layers. The mechanisms proposed to account for these discrepancies are related to band gap reduction and a position-dependent recombination rate. In the considered investigation, a review is provided of the involved physical relations, taking into account minority carrier mobility, minority carrier lifetime, minority carrier diffusion length, band gap narrowing, and Fermi-Dirac statistics. A comparison is conducted between theory and experiment, giving attention to device structure and experimental results, the base current component, the emitter current component, and short-wavelength quantum efficiency. G.R.

A81-42491 **Module and solar cell values as a function of efficiency.** M. Wolf (Pennsylvania, University, Philadelphia, PA). *Solar Cells*, vol. 3, July 1981, p. 327-336. 5 refs.

The determination of solar cell value as a function of efficiency provides a valuable tool for the selection of modules for a given system or for the assessment of the cost effectiveness of solar cell and module fabrication processes. This value-efficiency relationship is dominated by the area-related balance-of-system costs (ARBOS). Their future magnitude, however, is rather uncertain. An assumption of this magnitude will radically influence the direction of photovoltaic module research and development to be undertaken. To illustrate the effect of array installation costs, a graph presents four curves of module value as a function of efficiency with ARBOS costs as parameter. G.R.

A81-42492 **High efficiency bifacial back surface field solar cells.** A. Cuevas, A. Luque, J. Eguren, and J. del Alamo (Madrid, Universidad Politécnica, Madrid, Spain). *Solar Cells*, vol. 3, July 1981, p. 337-340. 6 refs.

The first high efficiency p(plus)-n-n(plus) bifacial solar cells are presented. Efficiencies of 15.7 percent and 13.6 percent were measured under front and back air mass 1 illumination, respectively, at 28 C. At 7 air mass 1 illumination and 28 C, the front efficiency increases to 16.5 percent. A pilot production of 200 cells was made following a fabrication process as simple as that for conventional back surface field cells. Mean efficiencies of 13.4 percent and 10.7 percent were obtained under front and back illumination, respectively. The production yield is higher than 80 percent. (Author)

A81-42493 **Growth patterns of chemiplated Cu/2-x/S layers in CdS/Cu2S thin film solar cells.** S. Saikalachen, S. Jatar, A. C. Rastogi, and V. G. Bhide (National Physical Laboratory, New Delhi, India). *Solar Cells*, vol. 3, July 1981, p. 341-353. 20 refs. Research supported by the Tata Energy Research Institute.

An investigation is conducted of the kinetics of growth of chemiplated Cu(2-x)S films on thermally deposited and chemically etched CdS layers. Efficient CdS/Cu2S thin film solar cells are generally prepared by chemically plating vacuum-deposited CdS layers in CuCl solution. Before chemiplating, the CdS film surface is texturized to enhance its light absorption properties and to increase the active junction area. It is found that the texturizing step preceding chemical plating alters the growth mechanisms of the Cu(2-x)S layer considerably, since both the morphology and the composition of the host CdS layer are affected. The Cu(2-x)S growth equations and variations in the deposit angle with the grain boundary edge are discussed on the basis of a pyramidal grain model. G.R.

A81-42494 **Theoretical bases of photovoltaic concentrators for extended light sources.** A. Luque (Madrid, Universidad Politécnica, Madrid, Spain). *Solar Cells*, vol. 3, July 1981, p. 355-368. 10 refs.

The theoretical bases for casting maximum energy on a cell placed in a static concentrator of minimum entry aperture are derived. Several concentrators are analyzed according to this theory and the gain achievable with each is obtained. When practical materials are used the maximum gain is about 9 for the direct beam source and about 4.5 for diffuse radiation. One of the concentrators analyzed allows for reaching these figures. (Author)

A81-42495 Application of electrochemical methods in Ga/1-x/Al/x/As/GaAs solar cell fabrication. J. Przyluski, J. Mendyk, and N. Druto (Warszawa, Politechnika, Warsaw, Poland). *Solar Cells*, vol. 3, July 1981, p. 369-374.

The discussed investigation had the objective to produce a Ga(1-x)Al(x)As/GaAs heterojunction model solar cell with an antireflection (AR) coating. An n(+) Te-doped (100)-oriented GaAs single crystal with a carrier concentration of 10 to the 18th per cc was used as substrate. Three successive layers n/p/p(+) were grown on the substrate by liquid phase epitaxy. Anodic oxidation was carried out by a galvanostatic method. An ellipsometric method with an He-Ne laser was employed to measure the thickness of the anodic layer. Ohmic contacts were prepared with the aid of standard photolithographic techniques. The investigation demonstrated the possibility to employ electrochemical methods in solar cell production of the considered type. G.R.

A81-42516 Space Shuttle and solar power satellite systems. G. M. Hanley (Rockwell International Corp., Pittsburgh, PA). In: Update on space. Volume 1. Granada Hills, CA, National Behavior Systems, 1981, p. 106-125.

The most significant fact about the Shuttle is that it makes it possible to place men and materials into orbit in a routine manner. Solar power satellites use solar cells to convert solar energy on orbit into electrical energy which is transmitted down to the ground using radio frequency waves which are received by a ground antenna and turned into direct current electrical energy. The satellite is in geosynchronous orbit. At this altitude sunlight is present approximately 98% of the time. A typical satellite is roughly 10 miles long and about 2-1/2 miles wide. It is assembled on orbit, with the materials brought up from earth. Each satellite produces 5 gigawatts of power. Plans are to start construction on solar power satellites around the year 2000. Energy-providing space systems which have been rejected after an evaluation include a nuclear reactor in space and a solar thermal system. The selected photovoltaic system will possibly use gallium aluminum arsenide cells instead of silicon cells. Attention is also given to problems of microwave energy transmission, details of satellite construction, and aspects of cost. G.R.

A81-42533 # Some aspects of the choice and design of antenna systems for satellite solar power stations (Nekotorye aspekty vybora i postroeniia antennykh sistem solnechnykh kosmicheskikh elektrostantsii). N. A. Armand, A. N. Lomakin, and B. M. Paramonov. *Radiotekhnika i Elektronika*, vol. 26, July 1981, p. 1479-1487. 7 refs. In Russian.

Various aspects of the design of microwave power transmitting and receiving antennas in satellite solar power systems are discussed. Particular consideration is given to problems of receiving-antenna design in Eastern European countries, where safety norms specify lower levels of microwave intensity than in the United States. Attention is also given to problems of sidelobe reduction in phased arrays consisting of a chain of a large number of nonlinear amplifiers series-connected by waveguides with slot radiators. Conditions for the damping of amplitude-modulated and phase-modulated oscillations in the chain are established, and the value of the suppression coefficient is determined. B.J.

A81-42638 Determination of the maximum efficiency solar cell structure. H. Pauwels and A. De Vos (Gent, Rijksuniversiteit, Ghent, Belgium). *Solid-State Electronics*, vol. 24, Sept. 1981, p. 835-843. 13 refs.

A very general formulation of a semiconducting photovoltaic device is given. The efficiency of this device is maximized with respect to its structural parameters. In this way it is shown that no solar cell structure can achieve a larger efficiency than an infinite tandem cell, with bandgaps monotonically decreasing from infinity to zero, and of which each individual cell is a selective black body with its own appropriate bias voltage. This maximum efficiency is numerically calculated for various cell- and sun temperatures and concentration factors. (Author)

A81-42640 Barrier height enhancement of the Schottky barrier diode using a thin uniformly-doped surface layer. C.-Y. Wu (National Chiao Tung University, Hsinchu, Nationalist China). *Solid-State Electronics*, vol. 24, Sept. 1981, p. 857-862. 13 refs. Research supported by the National Science Council of Nationalist China.

An analytic model for the barrier height enhancement of the Schottky barrier diode with the Mnp (or Mpn) structure, which considers the uniformly doped surface layer and the surface properties of the metal-semiconductor system, is presented. The maximum potential barrier and its precise location including the effect of the image-force potential have been calculated, which shows that the effective barrier height for the majority carriers without considering the image-force lowering will give erroneous predictions if the doped surface layer is very shallow or lightly doped. The built-in voltage of the Mnp structure based on the interfacial layer theory has also been calculated, which gives the exact dependence of the built-in voltage on the interface properties of the metal-semiconductor contact and the dose of the doped surface layer. Numerical results of the developed model have been computed and discussed, which may serve as the guide for the fabrication of the Schottky barrier (SB) and MIS solar cells with higher barrier height. (Author)

A81-42641 Silicon nitride for the improvement of silicon inversion layer solar cells. R. Hezel (Erlangen-Nürnberg, Universität, Erlangen, West Germany). *Solid-State Electronics*, vol. 24, Sept. 1981, p. 863-868. 29 refs.

An experiment is presented which demonstrates the use of CVD Si-nitride films as a transparent dielectric, and which results in high-efficiency, long-term stability MIS/inversion layer (IL) solar cells. The film is deposited on single crystalline silicon by the SiH4/NH3 reaction at a significantly lower temperature than usual (600-650 C), and fixed positive interface charge densities of up to 7 x 10 to the 12th/sq cm, with excellent stability, are obtained. Utilizing the Si-nitride charge storage effect, the charge density is further increased up to greater than 10 to the 13th/sq cm, a value far above those achieved in MIS/IL solar cells up to now. The charge distribution is discussed, and an energy band diagram, modified according to new analytical results, is presented. It is concluded that because of its low deposition temperature, cell fabrication could be reduced to a simple one mask process. The process could also be used for AR coatings on diffused junction solar cells. K.S.

A81-42650 * # Photoproduction of I2, Br2, and Cl2 on n-semiconducting powder. B. Reichman (Christopher Newport College, Newport News, VA; Energy Conversion Devices, Inc., Troy, MI) and C. E. Byvik (NASA, Langley Research Center, Hampton, VA). *Journal of Physical Chemistry*, vol. 85, July 23, 1981, p. 2255-2258.

The photosynthetic production of Br2 and Cl2 and the photocatalytic production of I2 from aqueous solutions of the respective halide ions in the presence of platinized semiconducting n-TiO2 powder are reported. Reactions were produced in 2-3 M oxygen-saturated aqueous solutions of KI, KBr or NaCl containing Pt-TiO2 powder which were irradiated by a high-pressure mercury lamp at a power of 400 mW/sq cm. Halogens are found to be produced in greater quantities when platinized TiO2 powders are used rather than pure TiO2, and rates of halogen production are observed to increase from Cl2 to Br2 to I2. The presence of the synthetic reactions producing Br2 and Cl2 with a net influx of energy indicates that an effective separation of the photoproduced electron-hole pair occurs in the semiconductor. Quantum efficiencies of the reaction, which increase with decreasing solution pH, are found to be as high as 30%, implying a solar-to-chemical energy conversion efficiency between 0.03% and 3% for the case of chlorine production. It is concluded that the photoproduction of halogens may be of practical value if product halogens are efficiently removed from the reaction cell. A.L.W.

A81-42686 The potential for thin-film photovoltaic cells. T. W. F. Russell and V. L. Dalal (Delaware, University, Wilmington, DE). *IEEE Transactions on Education*, vol. E-24, Aug. 1981, p. 239-242. 10 refs.

In this paper the potential for photovoltaic power generation is considered in terms of the photovoltaic generation facilities and the facilities for manufacturing the cell material. Significant quantities of electricity require very-large-scale manufacturing facilities and the

need for new innovative technology to design such facilities is discussed. (Author)

A81-42851 nydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volumes 1, 2, 3 & 4. Conference sponsored by the U.S. Department of Energy, Ministry of Education, Science and Culture of Japan, Ministry of International Trade and Industry of Japan, et al. Edited by T. N. Veziroglu (Miami, University, Coral Gables, FL), K. Fueki (Tokyo, University, Tokyo, Japan), and T. Ohta (Yokohama National University, Yokohama, Kanagawa, Japan). Oxford and New York, Pergamon Press (Advances in Hydrogen Energy 2), 1981. Vol. 1, 594 p.; vol. 2, 707 p.; vol. 3, 510 p.; vol. 4, 745 p. Price of four volumes, $300.

Papers are presented in the areas of electrolytic hydrogen production, thermochemical and hybrid hydrogen production, innovative hydrogen production, hydrogen storage and transmission, vehicles and hydrogen combustion, chemical and metallurgical usage of hydrogen, overall systems, environmental and materials aspects of hydrogen energy, and industrial aspects of hydrogen energy. Specific topics include advanced alkaline water electrolysis plants, polyethylene-based solid polymer electrolytes, the sulfur-iodine thermochemical water-splitting cycle, hydrogen, carbon monoxide, and char production by flash coal carbonization, photoassisted water electrolysis by Si electrodes, hydrogen production by a thermophilic blue-green alga, the hydrogen storage properties of Fe(1-x)Nb(x)Ti alloys, and hydrogen-fueled compression-ignition engines. Attention is also given to ammonia as an energy vector for the hydrogen economy, a solar hydrogen energy system for an isolated island, a photovoltaic electrolysis system, and the economics of synthetic fuel and chemical production from nuclear power and coal. A.L.W.

A81-42907 Solar heat storage by metal hydrides. M. Yamaguchi, I. Yamamoto, and T. Ohta (Yokohama National University, Yokohama, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2.
Oxford and New York, Pergamon Press, 1981, p. 931-936.

A theoretical and experimental study is presented of a solar heat storage system using metal hydrides, in an effort to overcome the problem of intermittent insolation. A numerical system analysis is performed, with consideration given to the dynamic characteristics of metal-hydrogen systems, the relative amounts of the hydrogen and the metal, and the reservoir volume. The experimental apparatus, which consists mainly of a hydrogen channel and a water channel, is described. Heat storage experiments using sintered FeTi alloy are compared with the system analysis, and the heat of reaction is estimated (from the dependence of the hydrogen flow rate on the thermal output) to be -6.9 kcal/mole H2. Examples are given of the time variation of pressure, hydrogen flow rate, and other variables in the heat storing and using cycle. The construction and operation of a solar heat storage system is described. K.S.

A81-42945 Performance of photovoltaic electrolysis system. D. Estève, C. Ganibal (CNRS, Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse, France), D. Steinmetz, and A. Vialaron (CNRS, Toulouse, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3.
Oxford and New York, Pergamon Press, 1981, p. 1593-1603. 7 refs.

A photovoltaic generator with concentrated light is combined with a water electrolysis cell in an effort to further the development of solar energy utilization. SOPHOCLE, a photovoltaic generator with limited concentration of energy, is a heliostat of the altazimuth type, consisting of an optical device to focus the sunlight on the photocells, a tracking device to follow the position of the sun, and a cooling device to allow dissipation of thermal energy. The combined cost and performance of SOPHOCLE gives an overall efficiency of 9 percent (for direct solar radiation). A power conditioning device matches the generator photocell characteristics with the electrolysis cell to give maximum hydrogen production. Hydrogen can be produced by this method with an overall efficiency of 7 percent. J.F.

A81-42966 Reversible photovoltaic-electrochemical solar cell. M. Sharon and A. Sinha (Indian Institute of Technology, Bombay, India). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2047-2053. 5 refs. Research supported by the Tata Energy Research Institute.

The development of a novel solar electrochemical rechargeable battery is reported. The device uses n-BaTiO3 as photo-anode for charging by sunlight, and Pt electrodes for the dark, reverse reaction. The electrolyte is Ce(3+)/Ce(4+) solution, which behaves like a cathode during charging. The cell has a potential of 0.62 V and a current on the order of 0.20 mA/sq cm. The photo-current, photo-voltage and stability of the semiconductor electrode were measured, and the flat-band potential and carrier concentration were calculated from Mott-Schottky plots. In addition, the effect of pH and additives were studied at a frequency of 1 KHz. O.C.

A81-43024 A high performance solar powered thermoelectric generator. D. M. Rowe (University of Wales Institute of Science and Technology, Cardiff, Wales). *Applied Energy*, vol. 8, Aug. 1981, p. 269-273. 7 refs. Research supported by the British Gas Corp.

The efficiency of a single couple solar powered thermoelectric generator utilizing fine-grained Si-Ge alloy thermoelements and a selective solar absorbing coating is investigated as a function of operating temperature and solar concentration factor. Optical losses and heat losses are taken into account. Under optimal operating conditions, the overall efficiency of the device is computed to be in excess of 12 per cent when operating between room temperature and 1000 K. (Author)

A81-43025 The coefficient of performance for a solar absorption dual cycle. H. M. Sofrata, A. E. Nasser, and M. R. Megahed (Riyadh, University, Riyadh, Saudi Arabia). *Applied Energy*, vol. 8, Aug. 1981, p. 275-280.

A new selection criterion for solar powered dual absorption systems is presented, and a multidimensional definition for the coefficient of performance is suggested. The traditional definition, which does not define the heat input base, is found to create misleading results with respect to machine selection, causing the dual cycle to often be ignored. A lithium bromide dual absorption cycle is also presented, and is found appropriate for places where solar energy is available but water is scarce, thus eliminating the need for a cooling tower. D.L.G.

A81-43286 a-SiC:H/a-Si:H heterojunction solar cell having more than 7.1% conversion efficiency. Y. Tawada, H. Okamoto, and Y. Hamakawa (Osaka University, Toyonaka, Japan). *Applied Physics Letters*, vol. 39, Aug. 1, 1981, p. 237-239. 19 refs.

A81-43290 Submicron polycrystal silicon film solar cells. P. H. Fang, C. C. Schubert, J. H. Kinnier (Boston College, Chestnut Hill, MA), and D. Pang (Boston College, Chestnut Hill, MA; Beijing Polytechnic University, Beijing, Communist China). *Applied Physics Letters*, vol. 39, Aug. 1, 1981, p. 256-258. 17 refs. Research supported by the U.S. Department of Energy.

A silicon polycrystal thin-film solar cell with a present efficiency of 1% is reported. The process involves depositing a silicon film by electron beam evaporation on metal layers with steel as the substrate. The thickness of the p-i-n structure is about 5 microns. The grain size is of the order of several hundred angstroms. Some similarities of this submicron silicon with amorphous silicon are discussed. (Author)

A81-43293 Observation of grain boundary hydrogen in polycrystalline silicon with Fourier transform infrared spectroscopy. D. S. Ginley and D. M. Haaland (Sandia Laboratories, Albuquerque, NM). *Applied Physics Letters*, vol. 39, Aug. 1, 1981, p. 271-273. 17 refs. Contract No. DE-AC04-76DP-00789.

A81-43400 HTE visits - An overview of SERI solar thermal research facilities. H. F. Kreith (Solar Energy Research

Institute, Golden, CO). *Heat Transfer Engineering*, vol. 2, Jan.-June 1981, p. 16, 17, 19-21, 134-137.

The objectives of investigations conducted in the Heat and Mass Transfer Research Laboratory are related to the study and the improvement of methods of transferring heat and mass under the small driving forces which often exist when the sun is the energy source for the process. The primary method under consideration is direct contact between the working fluid and the reservoirs, but other methods such as enhanced contact area may be studied. The near-term objective of laboratory research is to investigate the heat and mass transfer phenomena relevant to various open-cycle ocean thermal energy conversion systems. The objectives of the Advanced Component Research Facility include the development and evaluation of innovative concepts to improve high-temperature solar energy collection and conversion devices. The Mid-Temperature Collector Research Facility is dedicated to the investigation of a variety of research issues relating to the thermal performance of concentrating of solar collectors. Capability and equipment of the three facilities are described. G.R.

A81-43514 Tunneling solar cell under concentrated light illumination. A. Myszkowski, L. E. Sansores, and J. Tagüena-Martinez (Universidad Nacional Autónoma de México, Villa Obregon, Mexico). *Journal of Applied Physics*, vol. 52, June 1981, p. 4288-4296. 36 refs.

The behavior of ITO-SiO(x)-pSi tunneling solar cell (MIS type) under concentrated light illumination is analyzed theoretically. Conversion efficiency as high as 22.7 percent is predicted at 75 x AM1 illumination. At still higher light concentration the efficiency drops mainly owing to the resistance of the SiO(x) layer. The numerical calculations show the important role of the interface states in the tunneling process, electrical charge storage, and carrier recombination. Large current flowing through the diode can induce significant quasi-Fermi level drop across the insulator layer and electric charge storage in the depletion region. The operation of the diode cannot be explained by the standard MIS theory of low current densities. Therefore a more general treatment is presented. (Author)

A81-43518 Optimum design for window layer thickness of GaAlAs-GaAs heteroface solar cell regarding the effect of reflection loss. A. Yoshikawa and H. Kasai (Chiba University, Chiba, Japan). *Journal of Applied Physics*, vol. 52, June 1981, p. 4345-4347. 9 refs.

Optimum design for a window layer thickness of GaAlAs-GaAs heteroface solar cell has been performed regarding the effect of reflection loss. It is shown that the GaAlAs layer thickness greatly affects the reflection characteristics of the cell and that there is an optimum thickness for the GaAlAs layer. Thus the GaAlAs layer thickness must be designed so as to minimize the reflection loss as well as the absorption loss by the window. Optimum thickness for the GaAlAs layer is about 0.03 microns, and the power reflection loss for the cell with optimized double antireflection (AR) coatings is as low as 1.09% for AM0 solar radiation. (Author)

A81-43717 CdS based solar cells - Review and present status. L. C. Burton (Virginia Polytechnic Institute and State University, Blacksburg, VA). In: SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 116-118. 7 refs.

The CdS/Cu2S solar cell - the highest efficiency thin film solar cell yet reported - is reviewed. Limiting mechanisms that result in a reduction of open circuit voltage are discussed. Recent measurements made on a modified structure (CdZnS/Cu2S) are reviewed, and a modified model that can account for differences between CdS and (Cd,Zn)S based solar cells is presented. The potential and high priority research areas related to (Cd,Zn) based cells are also discussed. (Author)

A81-43718 * Second quadrant effects in silicon solar cells. R. A. Hartman, J. L. Prince, and J. W. Lathrop (Clemson University, Clemson, SC). In: SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 119-122. Research sponsored by the U.S. Department of Energy and NASA.

A simple model describing the behavior of a solar cell in the second quadrant of the I-V curve is described. In this mode of operation appreciable power is dissipated in the cell leading to thermal breakdown and the formation of hot spots. These hot spots will be stable in a current limited mode of operation. In addition a simple method is described to locate the hot spots. (Author)

A81-43719 * Direct solar-pumped lasers. J. H. Lee (Vanderbilt University, Nashville, TN), Y. J. Shiu (Hampton Institute, Hampton, VA), and W. R. Weaver (NASA, Langley Research Center, Hampton, VA). In: SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 126-131. Grants No. NCC1-8; No. NsG-1595.

The feasibility of direct solar pumping of an iodine photodissociation laser at lambda = 1.315 microns was investigated. Threshold inversion density and effect of elevated temperature (up to 670 K) on the laser output were measured. These results and the concentration of solar radiation required for the solar pumped iodine laser are discussed. (Author)

A81-43725 Solar energy and energy management microcomputer controller evolution. T. M. Murray, Jr. (Louisville, University, Louisville, KY). In: SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 289-292.

The design and development of six microprocessor-based systems for the control of energy systems including those utilizing solar energy are summarized with particular emphasis on data sensors and the interface circuitry required for communication between the sensors and the microprocessors. The initial system collects data from 14 sensors and a clock with date information in order to control the solar heating and cooling system of an 1800-sq ft building; it is based on an Intel 8080 CPU. The next system, currently under implementation, was designed to control the lighting and HVAC systems of medium-sized buildings based on the use of a Z-80 CPU. The third system was built for the control of a domestic solar water heating system and employs an Intel 8748 chip. A fourth system, a low-cost microcomputer solar energy control and monitoring system for a private home with an air solar heating system, uses an Intel 8035 chip. A further system is used to control a fractional distillation column for the one-pass production of 160-187 proof ethanol, based on a Z80 microprocessor. The final system is a portable power factor meter based on an Intel 8748 microprocessor chip. A.L.W.

A81-43800 Financial transactions between the electric utility and the solar photovoltaic system owner. Z. A. Yamayee and J. Peschon (Systems Control, Inc., Palo Alto, CA). *(Institute of Electrical and Electronics Engineers, Winter Meeting, Atlanta, GA, Feb. 1-6, 1981.) IEEE Transactions on Power Apparatus and Systems*, vol. PAS-100, Aug. 1981, p. 3960-3967; Discussion, p. 3968. 17 refs.

Residential customers with surplus solar photovoltaic (SPV) energy in excess of their load have the option of either selling that energy or storing it in batteries and consuming it later. Their choice of the option depends on the financial transaction contract between such households and the electric utility. The buy-back ratio can be used to characterize the financial transactions between the utility and the SPV owner. This paper addresses the issue of buy-back ratio and its implications. It describes how the buy-back ratio is going to affect the transaction between the SPV owner and the utility. Many components that affect the buy-back ratio are discussed from the electric utility perspective. A range of buy-back ratio is determined from the utility point of view. (Author)

A81-43809 Radiative heating and cooling with spectrally selective surfaces. C. G. Granqvist (Chalmers Tekniska Hogskola, Goteborg, Sweden). *Applied Optics*, vol. 20, Aug. 1, 1981, p. 2606-2615. 349 refs.

Ambient radiative properties are examined. For the temperatures of interest in connection with natural heating and cooling, the Planck spectrum is confined to the wavelength range from 3 to 50

micrometers. Solar radiation is limited to the range from 0.25 to 3 micrometers. A surface may, therefore, have different properties with respect to solar and thermal radiation. Attention is given to surfaces with high solar absorptance and low thermal emittance, surfaces for radiative cooling to low temperatures, transparent heat mirrors, and green leaves. An extensive list of literature references concerning the different surface types is provided. The importance of spectral selectivity for efficient photothermal conversion of solar energy was pointed out several decades ago. Recently the interest in solar energy applications had led to an active development of selective surfaces. Practical solar energy collectors use surfaces consisting of black chrome, black nickel, electrolytically colored anodic alumina, and copper oxide. G.R.

A81-44045 Transient analysis of solar air heaters using a finite difference technique. H. P. Garg, R. Chandra, and U. Rani (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research*, vol. 5, July-Sept. 1981, p. 243-252. 7 refs.

The transient heat transfer model of a solar air heater is developed and the resulting system is solved by using an explicit finite difference technique. The solar radiation data and the ambient temperature have been represented by a Fourier series in the numerical calculations. The effects of various design parameters of the heater on its performance are studied. (Author)

A81-44046 Influence of errors of trough pointing and fin alignment on the geometrical concentration ratio of focusing parabolic concentrators. S. S. Mathur, T. C. Kandpal, R. N. Singh, and A. K. Singhal (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research*, vol. 5, July-Sept. 1981, p. 277-287. 7 refs.

Geometrical behavior of a focusing parabolic trough with a fin receiver has been studied in detail keeping in view the interesting application of this system for photovoltaic conversion of solar energy through double-sided and multiple-junction edge illuminated solar cells. Results regarding the influence of the pointing errors of the trough and alignment errors of the fin on the geometrical concentration ratio of the system are presented. (Author)

A81-44149 Electrochemical solar cells with layer-type semiconductor anodes - Performance of n-MoSe2 cells. G. Razzini, M. Lazzari, L. P. Bicelli (CNR, Centro Studio Processi Elettrodici, Milan, Italy), F. Levy (Lausanne, Ecole Polytechnique Fédérale, Lausanne, Switzerland), L. de Angelis, F. Galluzzi, E. Scafè (Laboratori di Ricerche di Base, Monterotondo, Italy), L. Fornarini, and B. Scrosati (Roma, Università, Rome, Italy). *Journal of Power Sources*, vol. 6, Oct. 1981, p. 371-382. 11 refs.

Output characteristics and long-term performances of n-MoSe2 (I-, I2) electrochemical solar cells are investigated, and the role of the surface state of the semiconductor with layer-type, d-band transition metal dichalcogenide systems is established. Fill factor values of 0.6 and efficiency values of 6 percent are obtained under AM1 illumination using smooth crystal samples, with values significantly reduced using irregular crystal samples. Chemical treatments specific to the unsaturated transition metal atoms exposed to the electrolyte at edge sites are used in an attempt to control surface state effects. Finally, the stability of the MoSe2 (I-, I2) cells under long time operation is evaluated, and long-term stability was achieved, delivering a continuous output of 10 mA/sq cm without appreciable degradation. D.L.G.

A81-44150 Thermal damage in luminescent solar concentrators /LSC/ for photovoltaic systems. F. J. Meseguer Rico, F. Jaque (Consejo Superior de Investigaciones Científicas, Instituto de Física del Estado Sólido; Madrid, Universidad Autónoma, Madrid, Spain), and F. Cussó (Madrid, Universidad Autónoma, Madrid, Spain). *Journal of Power Sources*, vol. 6, Oct. 1981, p. 383-388. 8 refs. Research supported by PLEXI, S.A. and Comisión Asesora de Investigación Científica y Técnica.

The dependence of optical efficiency on temperature in luminescent solar concentrators (LSC) is studied. It is found that for temperatures in the range of 20 to 100 C the LSC experiences significant thermal degradation and a decrease in the efficiency of conversion of the solar spectrum. Damage is also found to depend on the nature of the dye, and can reach values up to 37 percent, as observed with Rhodamine B. A partial recovery of damage is obtained when LSC is cooled to room temperature range, and the origin of the damage is discussed. D.L.G.

A81-44316 The THEK program - Perspectives on development (Le programme THEK - Perspectives de développement). G. Peri (Aix-Marseille I, Université, Marseille, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Semester, 1981, p. 4-7. In French.

The status of work carried out within the framework of the THEK program for the development of solar thermal energy conversion units is reviewed. The first phase of the program, begun in 1975, has confirmed the theoretical feasibility of using distributed solar thermal conversion modules with operating temperature up to 320 C, instantaneous global efficiencies greater than 0.72 and daily energy efficiencies of approximately 0.70, leading to an annual heat production of 50 to 55 MWh for a 50-sq m module in the Marseille region. The second stage of the program has resulted in the construction of two experimental installations: a unit to be coupled to a thermodynamic conversion loop operating at about 275 C which is based on a thermal oil as a working fluid, and a unit for the direct production of industrial steam. The second installation uses pressurized water both at the storage medium and the heat transfer medium, with an optimum arrangement of collectors, automatic control of collector pointing and the pumping of pressurized water through the collectors and heat exchanger, and steam production by the expansion of gas in a reservoir. A.L.W.

A81-44317 Optical properties of linear parabolic concentrators of large area - Experimental results. C. Bellecci, A. Bonanno, M. Camarca, M. Conti, G. Garofalo, S. Racalbuto, and R. Visentin (Calabria, Università, Cosenza, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Semester, 1981, p. 8-10.

A parabolic trough solar concentrator with a 2.5-m aperture has been developed which may be used with both a thermodynamic receiver and a photovoltaic array. The present paper presents results of the measurement of the optical properties of the modular concentrator, which limit its performance in photovoltaic applications. The concentration of the collected energy in the focal zone was monitored by the use of a laser beam to illuminate sections of the trough reflecting surface at various angles of incidence and collector inclinations. A new concentration factor defined as the product of the geometric concentration factor with the cosine of the incidence angle at which the radiation strikes the photocell array was then determined for various sections of the trough as a function of trough aperture. These tests have allowed the definition of the size and shape of a prototype photovoltaic converter currently under construction. A.L.W.

A81-44318 Development and future prospect of gravity-controlled solar concentrators. C. Pontiggia, G. A. Rottigni (Genova, Università, Genoa, Italy), and C. Bellecci (Calabria, Università, Cosenza, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 1st Semester, 1981, p. 11-14. 8 refs.

The theoretical development of the gravity-controlled solar concentrator is reviewed, and results of an experimental study of model concentrator characteristics are presented. The advantages and potential applications of a gravitationally deformed lamina used as the reflecting surface of a solar concentrator are discussed, and the evolution of the concept from that of a reflector surface deformed solely by the force of gravity into a catenary curve to that of a variable-density lamina with one mobile end which is tracked with solar position to produce a parabolic reflector with a constant focus is examined. Experimental measurements of the concentration factors obtained with a model concentrator composed of a 3-m long, 0.2-mm thick reflecting lamina with two mobile ends mounted on a frame are then presented as a function of the number of small chains hung from each side of the lamina for the purpose of varying laminar density with end height. The results obtained are noted to confirm the theoretical possibility of building solar concentrators with heretofore unattainably large apertures, and verify the feasibility of the use of hanging chains to vary reflector density. A.L.W.

A81-44319 Multipass air solar collectors (Les insolateurs à air multipasses). P. Granier and M. Daguenet (Perpignan, Université, Perpignan, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 21-25. 5 refs. In French.

Instantaneous thermal efficiencies are calculated for flat-plate solar collectors of various configurations which use air exposed to solar radiation or the solar absorber one or many times as the heat transport medium. The efficiencies of 18 potential models are obtained from numerical calculations of air flow and thermal loss distribution in the collector channels, incident solar radiation, solar radiation absorption, and the energy balance and air temperature increase following each pass through the collector. Plots of the instantaneous thermal efficiency as a function of inlet air temperature under standard operating conditions reveal that, if nonselective materials are used for the collector, models utilizing one or two covers with air flow only behind the solar absorber are most suitable, with only a few models with one cover and one selective surface having higher performance than the most efficient two-cover model with nonselective materials. For relatively high air inlet temperatures, a model with two covers and one selective surface having air flow only behind the absorber is also found to be superior. In the case of models with two selective covers, highest performance was obtained for models with parallel air flow in front of and behind the absorber, and flow only behind the absorber. It is noted that the use of two selective surfaces is, however, not justified at low inlet temperatures. A.L.W.

A81-44320 A simplified non-linear model leading to full range valid calibration test of thermal solar collectors through simple experimental procedure. G. Y. Saunier (Asian Institute of Technology, Bangkok, Thailand). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 26-34. 8 refs.

A simple, nonlinear model of the thermal characteristics of a solar collector is presented which is intended for use in the evaluation of the performances of various solar collectors at a given site based on a few simple experimental measurements. The model relies on a simplified equivalent network representing the thermal properties of the collector under various assumptions concerning the heat loss from the plate. The useful energy gain of the collector can be determined according to the model and measurements of collector performance, including the thermal loss coefficient through the back and sides of the collector, the stagnation temperature, and first- and second-order heat transfer coefficients through the front of the collector. Comparison of model predictions with those of an accurate simulation computer program for a single-glass cover flat plate thermal collector with a selective coating on the absorber and a doubly glazed flat plate collector with black paint on the absorber indicates that the model is capable of predicting accurately the performance of solar collectors working under conditions very different from those prevailing during the determination of collector intrinsic parameters. A.L.W.

A81-44321 A study of the mirror coupling of solar photocells in concentrated sunlight (Etude sous concentration du couplage par miroir de photopiles solaires). J.-R. Leguerre (Rabat, Faculté des Sciences, Rabat, Morocco; Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse, France), A. Chave, and M. Leroy (Rabat, Faculté des Sciences, Rabat, Morocco). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 1st Semester, 1981, p. 47-55. 16 refs. In French.

A study is presented of the photovoltaic characteristics of solar cells with complementary band gaps coupled by a dichroic mirror in concentrated sunlight. The photocurrents and cell efficiencies were determined based on an analytical model of photovoltaic cell operation taking into account series resistances and shading rates for the case of a p(plus)-n junction GaAs cell coupled to an n(plus)-p Ge cell. By a suitable choice of the surface recombination rates and junction depths of the materials and the inclination and cut-off wavelength of the mirror, a peak efficiency of 28.5 percent is obtained under a concentration factor of 600 and AM 1 illumination with an optimum collection grid profile. A.L.W.

A81-44333 A low-cost efficient and durable low-temperature solar collector. T. P. O'Donnell (Solar Materials, Inc., Altadena, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 101-107.

The considered collector utilizes a material made of ethylene-propylene-diene-monomer (EPDM). This material has been used in solar systems to heat domestic water, pools, spas, and homes by radiant energy. EPDM or ethylene propylene rubber compounds are synthetic elastomers. EPDM elastomers combine superior ozone, good heat and oxygen resistance, and very good low temperature properties to produce a compound with excellent overall age resistance. The material is extruded into 4.4 inch wide mats. Each mat has six small tubes alternating with thin webbing. The absorber mat will adhere to any clean building surface with the use of thermosetting construction-grade mastic adhesive. Carbon black contained in the mat material acts to increase the solar absorptivity. Their low cost makes the elastomers commercially very attractive. The efficiency and durability of the material are discussed. G.R.

A81-44335 * Molybdenum-tin as a solar cell metallization system. D. W. Boyd and C. Radics (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 119-124. Research sponsored by the U.S. Department of Energy and NASA.

The operations of solar cell manufacture are briefly examined. The formation of reliable, ohmic, low-loss, and low-cost metal contacts on solar cells is a critical process step in cell manufacturing. In a commonly used process, low-cost metallization is achieved by screen printing a metal powder-glass frit ink on the surface of the Si surface and the conductive metal powder. A technique utilizing a molybdenum-tin alloy for the metal contacts appears to lower the cost of materials and to reduce process complexity. The ink used in this system is formulated from MoO3 with Sn powder and a trace amount of titanium resonate. Resistive losses of the resulting contacts are low because the ink contains no frit. The MoO3 is finally melted and reduced in forming gas (N2+H2) to Mo metal. The resulting Mo is highly reactive which facilitates the Mo-Si bonding. G.R.

A81-44629 Space manufacturing studies for SPS. D. B. S. Smith (MIT, Cambridge, MA). In: Space - Enhancing technological leadership; Proceedings of the Twenty-seventh Annual Meeting, Boston, MA, October 20-23, 1980. San Diego, CA, American Astronautical Society; Univelt, Inc., 1981, p. 229-246. 8 refs. (AAS 80-223)

Two aspects of the production of Solar Power Satellites (SPS), i.e., manufacture of components, and assembly in space of large structures for an SPS, are reviewed. A solar cell factory design is presented by describing a reference in-space facility, which receives beneficiated raw materials from the moon, logistics and some raw materials from the earth, and energy from the sun; it produces components of one 10-gigawatt SPS per year. A cost summary of the reference system is also given. Research is conducted on underwater simulation of human assembly of large space structures in zero-g, and simulation of a truss-structure assembly is described. It is concluded that although automation is desirable for repetitive manufacturing operations and special situations, replacing personnel by machinery will not yield significant reductions in program costs. K.S.

A81-44702 Evaluation of heat transfer enhancement in air-heating collectors. D. L. Mattox (Northrop Services, Inc., Huntsville, AL). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 330-332.

Results of a study of means for improving the heat transfer coefficient between the solar energy absorbers and the air stream in an air-heating solar collector are outlined. Efforts undertaken in the study included the identification and evaluation of techniques for enhancing heat transfer, the development of a thermal model for the determination of the required conductance area product, the determination of the optimum flow Reynolds number ranges, the

evaluation of various fin designs, and the development of empirical heat and momentum transfer relationships for scaling the state-of-the-art high conductance fin designs. Future activities proposed would include futher theoretical analysis and and an absorber heat exchanger test program to validate fin performance and establish an optimum configuration. A.L.W.

A81-44703 Residential load profiles for photovoltaic simulation studies. J. F. Rudisill and J. W. Lathrop (Clemson University, Clemson, SC). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 333-338. 8 refs. Research supported by the U.S. Department of Energy.

In order to analyze the performance of photovoltaic (PV) systems in residential applications, it is necessary to consider the load characteristics. This paper describes a computer based model which simulates the demand of a 'typical' residential customer. Input parameters allow the model to be customized for different lifestyles and different geographical locations. Previous research has utilized hourly intervals of the time domain, based on utility averages. Since the electrical demand (and solar supply) can change instantaneously, the continuous time feature is necessary in order to accurately analyze the effect of various load management strategies. The residential load was divided into heating-ventilating-air conditioning, water heating, and diversified components. The model incorporates the interactive effects of the three components as well as temporal, meteorological, and geographic effects. (Author)

A81-44843 Substrate heating and emitter dopant effects in laser-annealed solar cells. R. T. Young, R. F. Wood, W. H. Christie, and G. E. Jellison, Jr. (Oak Ridge National Laboratory, Oak Ridge, TN). *Applied Physics Letters*, vol. 39, Aug. 15, 1981, p. 313-315. 12 refs. Contract No. W-7405-ENG-26.

Experimental evidence is presented to demonstrate that substrate heating during pulsed-laser annealing (PLA) of ion-implanted silicon can significantly improve the electrical properties of the laser-recrystallized region, due to regrowth velocity reduction. Use of the optimum PLA condition shows qualitative agreement with theoretical predictions in that (1) the open-circuit voltage and fill factor of ion-implanted, laser-annealed solar cells are improved by the increase of emitter dopant concentrations, while (2) the short-circuit current remains fairly constant. O.C.

A81-44845 Image force effects on carrier collection in a-Si:H solar cells. M.-K. Han, W. A. Anderson, R. Lahri (New York, State University, Amherst, NY), and J. Coleman (Plasma Physics Corp., Locust Valley, NY). *Applied Physics Letters*, vol. 39, Aug. 15, 1981, p. 325-327. 12 refs. Contract No. XS9-8041-9.

A modified carrier collection model is proposed to account for the falloff of short wavelength carrier collection efficiency in a-Si:H Schottky-barrier solar cells. It is argued that the potential distribution near the metal-semiconductor interface is altered by Schottky-barrier lowering due to image force effects, lowering carrier collection in solar cells of the present type by as much as 30%. Design considerations for the improvement of carrier collection efficiency are proposed. O.C.

A81-45090 Photocurrent conversion efficiency in a Schottky barrier. H. S. Jarrett (Du Pont de Nemours and Co., Central Research and Development Dept., Wilmington, DE). *Journal of Applied Physics*, vol. 52, July 1981, p. 4681-4689. 18 refs.

The diffusion equation for an illuminated Schottky barrier is solved for a finite lifetime of photoinjected minority carriers within the barrier. The general solutions are related to parabolic cylinder functions when diffusivity and mobility are constant. These solutions are subject to the usual boundary conditions that at the surface the minority carrier current is proportional to the carrier density and that at the barrier/bulk interface the carrier density and its gradient are continuous. The photoconversion efficiency for a given impurity concentration is completely defined by three parameters: the charge transfer rate at the surface, the optical absorptivity, and the carrier lifetime. These calculations are applicable to many of the oxide semiconductors used as anodes in photoelectrolysis. (Author)

A81-45092 Strains and photovoltaic response in Ta-sputtered Si metal-insulator-semiconductor solar cells. B. Lalevic, K. Murty, T. Ito, Z. H. Kalman, and S. Weissmann (Rutgers University, Piscataway, NJ). *Journal of Applied Physics*, vol. 52, July 1981, p. 4808-4817. 16 refs. NSF Grant No. DMR-78-05930.

Deformation by bending of Si or Si-SiO2 wafers is achieved by sputter deposition of tantalum films. Strains induced at Si-SiO2 interface and in Ta films are investigated using a combination of X-ray diffraction, electron diffraction, and transmission electron microscopy. Thin Ta film deposits are found to have predominantly a fcc structure, while thicker films have the normal bcc structure with certain admixture of fcc. Film strains generated by the coexistence of the polymorph structure are accommodated by formation of misfit dislocations at the film-Si substrate interface. The effect of the induced stress on the electronic parameters characterizing the Si-SiO2 interface is studied in the metal-oxide-semiconductor structure, and for the effect on photovoltaic response a metal-insulator-semiconductor solar cell configuration is used. Large changes with increasing stress are observed in the values of recombination time, capture cross section, and diffusion length and in sharply decreased conversion efficiency, fill factor, open-circuit voltage, and short-circuit current. C.R.

A81-45094 Fabrication of P/+/-N-N/+/ silicon solar cells by simultaneous diffusion of boron and phosphorus into silicon through silicon dioxide. G. C. Jain, S. N. Singh, R. K. Kotnala, and N. K. Arora (National Physical Laboratory of India, New Delhi, India). *Journal of Applied Physics*, vol. 52, July 1981, p. 4821-4824. 12 refs. Research supported by the Ministry of Industrial Development.

A process of fabricating P(+)-N-N(+) silicon solar cells by simultaneous diffusion of boron and phosphorus into N-type silicon through a thermally grown silicon dioxide layer approximately 0.1 micron thick is described. The inherent problems of cross doping and the usefulness of silicon dioxide in minimizing them are briefly discussed. It is noted that the process is well suited for large-scale production of P(+)-N-N(+) back surface field silicon solar cells. Cells fabricated through this process from single-crystalline silicon wafers of 100 ohm-cm resistivity show open-circuit voltages of approximately 0.6 V at 28 C under 100 mW/sq cm (AM1) intensity, and cells fabricated from polycrystalline silicon wafers that are 1-2 mm in grain size and have 7-27 ohm-cm resistivity show conversion efficiencies between 10.4 and 11.4% (AM1) at 28 C. C.R.

A81-45166 # The determination of the optimal radiation concentration coefficients and concentrator parameters for solar batteries with radiative heat transfer (K opredeleniiu optimal'nykh koeffitsientov kontsentratsii izlucheniia i parametrov kontsentriruiushchikh sistem dlia solnechnykh batarei s radiatsionnym teplootvodom). V. A. Grilikhes, O. F. Zaitsev, and E. M. Men'shikov. *Geliotekhnika*, no. 3, 1981, p. 19-24. 12 refs. In Russian.

A81-45439 Solar thermochemistry and chemical engineering (Thermochimie et génie chimique solaires). J. Villermaux (CNRS, Laboratoire des Sciences du Génie Chimique, Nancy, France). *Entropie*, vol. 16, no. 96, 1980, p. 24-27. In French.

In 1978, the CNRS initiated a program designed to encourage French laboratories in the development of processes for the thermochemical conversion of solar energy and chemical processes employing solar energy. The present paper summarizes the results of 20 contracts concluded within this program between 1978 and 1980. Research was conducted in the areas of the chemical transfer and storage of solar energy, by means of reversible chemical reactions, the conversion of solar energy into chemical vectors by thermal or electrochemical processes resulting in hydrogen or fuel production, materials preparation processes by solar thermal methods, and solar chemical reactor development. A.L.W.

A81-45440 Photocell technologies (Les filières de photopiles). M. Rodot (CNRS, Meudon, Hauts-de Seine, France). *Entropie*, vol. 16, no. 96, 1980, p. 28-40. 33 refs. In French.

Currently promising technologies for the fabrication of photovoltaic solar cells are examined and compared in relation to the efficiencies and costs of the cells produced. The primary effort has been in the preparation of crystalline silicon of purity less than that

required for electronic applications for directly exposed solar cells. The processes under investigation include those leading to ingots (Czochralski, heat exchange, Bridgman, vacuum casting), ribbons (edge-defined film growth, web dendrite, ribbon-to-ribbon) and thin films deposited on inexpensive substrates (ribbon against drop, silicon on ceramic, chemical vapor deposition). Other work has involved the development of cells based on polycrystalline thin films of alternative semiconductors such as GaAs, InP and CdTe or amorphous silicon, and the reduction of solar cell requirements by the use of solar concentrators. It is noted that although these parallel developments have little chance of producing economic devices in the short term when prices as low as $1/peak Watt are expected, they have the potential to contribute to long-range energy reserves. A.L.W.

A81-45441 The optimal utilization of photovoltaic generators (Utilisation optimale de générateurs photovoltaiques). J. P. Requier, M. Barlaud, G. Chaumain, and P. Rouan (Institut Universitaire de Technologie, Dakar, Senegal). *Entropie,* vol. 16, no. 96, 1980, p. 41-47. 7 refs. In French.

Methods used to ensure optimal coupling between the output of a photovoltaic generator and the mechanical system receiving this output are discussed. Although the first approach to the problem may be to design the receiver with static characteristics adapted to those of the generator, it is pointed out that a more economical approach would be the insertion of one or two static converters to effect the adaptation. The converters may be based on the principle that the voltage allowing maximum photocell yield is constant to a first approximation, or based on the view of the generator as a dipole. The receiver can then be optimized so that the usable power is maximal at the operating point. Apparatus developed to allow the optimization of a photovoltaic generator-receiver system is presented, including a measuring system for the determination of electrical and physical parameters, and a programmable generator. The application of the methods outlined to the optimization of a photovoltaic generator coupled to a water pump by the use of a microprocessor-controlled chopper circuit is illustrated. A.L.W.

A81-45442 Heat and electricity production by distributed concentrating solar collectors (La production de chaleur et d'électricité par des collecteurs solaires distribués à concentration). J. L. Boy-Marcotte (Société Bertin et Cie., Plaisir, Yvelines, France). *Entropie,* vol. 16, no. 96, 1980, p. 66-73. In French.

Technical and economic parameters with which to establish the best compromise between price and performance in the design of distributed concentrating solar collectors to provide industrial process heat at powers on the order of 1 MW thermal and temperatures from 100 to 300 C are presented. Factors influencing the optimization of a solar thermal electricity plant comprised of collector, heat storage and thermal-electric converter subsystems are considered, including heat source temperature. Attention is then given to the costs and performances of distributed concentrating collectors developed in France, including a cylindroparabolic collector, a line-focus collector with segmented mirrors and a point-focus collector, and to the possible realizations of Rankine cycles based on heavy organic fluids for the conversion of thermal to mechanical energy. It is noted that two such organic fluid converters are to be installed on the 100 kWe distributed collector solar power plant on Corsica. A.L.W.

A81-45443 The Thémis 2500-kW solar power station (La centrale solaire Thémis 2500 kW). J. Hillairet (Electricité de France, Marseille, France). *Entropie,* vol. 16, no. 96, 1980, p. 78-84. In French.

The Thémis 2500-kW solar power station is being constructed at Targassonne in the eastern Pyrenees. A 201-heliostat field collects the solar radiation to direct it into a collector located on a 100-m-high tower. A molten-salt circuit carries the thermal energy to a storage unit, a temperature of 450 C corresponding to a sunny day. A turboalternator produces 2500 kW for 11,170 kW of collected power. B.J.

A81-45444 The Thémis heliostat field (Le champ d'héliostats de Thémis). A. Collon (Electricité de France, Marseille, France) and A. Leclerc (CETHEL, Neuilly-sur-Seine, Hauts-de-Seine, France). *Entropie,* vol. 16, no. 96, 1980, p. 84-94. In French.

The focusing of direct solar radiation at the Thémis solar power station in the eastern Pyrenees is accomplished by a field of 210 focusing heliostats. Each of the heliostats has a 54-sq-m surface of focusing mirrors consisting of silver-plated composite glass, assembled on a wire netting structure. A central control system with a hierarchy of three logic levels ensures open-loop tracking of the sun and heliostat safety in the case of the failure of the collector or of the heliostats themselves. The further development of heliostats is discussed in the light of experience gained with the Thémis field. B.J.

A81-45445 The Thémis solar collector (Le récepteur solaire Thémis). J. M. Gravrand (Constructions Navales et Industrielles de la Méditerranée, La Seyne-sur-Mer, Var, France) and X. Pouget-Abadie (Electricité de France, Marseille, France). *Entropie,* vol. 16, no. 96, 1980, p. 94-103. 5 refs. In French.

The design of a solar collector for a tower-type power station has to satisfy several requirements, including very high solar-flux concentration, high efficiency, and the allowance for the physical limits of the materials used. This paper describes the design and operation of the solar collector for the Thémis solar power station in the eastern Pyrenees; considerations which have led to the choice of the cavity, the fluid, and the type of circulation are examined. B.J.

A81-45446 Applications of solar heat in agriculture and industry (Les applications de la chaleur solaire dans l'agriculture et l'industrie). J. Deflandre, F. Moisan, P. Matarasso, and F. Valette (CNRS, Paris, France). *Entropie,* vol. 16, no. 96, 1980, p. 104-127. In French.

A81-45447 Chemistry and the concentration of solar radiation (Chimie et concentration du rayonnement solaire). A. Vialaron (CNRS, Laboratoire d'Energétique Solaire, Toulouse, France). *Entropie,* vol. 17, no. 97, 1981, p. 134-138. 10 refs. In French.

Thermodynamic and technological parameters influencing the efficiency of concentrating solar thermal energy conversion are considered. Expressions for the theoretical thermal, thermodynamic, heat pump and energy efficiencies of the absorption of solar radiation by a black body are presented in terms of the operating temperatures, and it is pointed out that the elevation of the operating temperature of solar collectors results in greater collector efficiency. The designs of concentrating collectors intended to achieve a higher operating temperature are indicated. Consideration is then given to the design of a reactor capable of absorbing such concentrated solar fluxes, and the principal criteria of heat transfer at the interface between the incident flux and the material to be heated and of the reactor specific energy productivity are indicated. The economics of concentrating solar collector technology is finally discussed in terms of the internal profitability rate of the investment. A.L.W.

A81-45448 Thermodynamic power stations at low temperatures (Centrales thermodynamiques à basse température). J. Malherbe (Société Française d'Etudes Thermiques et d'Energie Solaire, Montargis, Loiret, France), R. Ployart, T. Alleau, P. Bandelier, and F. Lauro (Commissariat à l'Energie Atomique, Paris, France). *Entropie,* vol. 17, no. 97, 1981, p. 161-168. In French.

The development of low-temperature thermodynamic power stations using solar energy is considered, with special attention given to the choice of the thermodynamic cycle (Rankine), working fluids (frigorific halogen compounds), and heat exchangers. Thermomechanical conversion machines, such as ac motors and rotating volumetric motors are discussed. A system is recommended for the use of solar energy for irrigation and pumping in remote areas. Other applications include the production of cold of fresh water from brackish waters, and energy recovery from hot springs. K.S.

A81-45516 Optimal control of solar energy collection in Solar House II at Colorado State University. R. C. Winn and C. B. Winn (Colorado State University, Fort Collins, CO). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 2 p. (WA10-F). Contract No. EG77-S-02-4159.

An optimal controller of the second kind is one which

maximizes the difference between the useful energy collected by a solar heating system and the associated pumping costs. This paper describes a method of implementing the optimal control strategy on a microprocessor based controller. The optimal controller built for Solar House II at Colorado State University, which has an air solar heating system, is described. Significant increases in the difference between energy collected and fan energy used were realized using optimal control. These increases were the greatest on the least sunny days. (Author)

A81-45526 Field experience with solar concentrating collector control systems. H. J. Gerwin (Sandia Laboratories, Albuquerque, NM). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 4 p. (WP3-A). Research supported by the U.S. Department of Energy.

Solar-concentrating collectors are tested and evaluated for performance of sun tracker system sensors, fluid control, and safety functions. Sun tracker system sensors which are tested include shadow-band, linear-concentrated flux, computer-driven (ephemeris), optical balance, and linear-flux integration. Safety circuits are tested to operate on signals such as over-temperature, insufficient fluid flow, and over-travel. Results are compared on the basis of field-test conditions, and component failures and corrective actions are discussed. The cost of a computer is found to be a disadvantage, although as sun tracking, fluid control and safety functions are integrated into a single unit, a central computer could amortize the cost over all the functions. D.L.G.

A81-45527 Analytical modeling of line focus solar collectors. J. D. Wright (Solar Energy Research Institute, Golden, CO). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 6 p. (WP3-C).

Solar thermal electric power generation systems and industrial process heat systems generating steam through flash vaporization require a constant outlet temperature from the collector field. This constant temperature is most efficiently maintained by adjusting the circulating fluid flow rate. Successful design of analog controllers for this regulation requires knowledge of system dynamics and the nonlinear nature of the system parameters. Simplified models relating deviations in outlet temperature to changes in inlet temperature, insolation, and fluid flow rate illustrate the basic responses and the distributed-parameter nature of line focus collectors. Detailed models are used to develop transfer functions and frequency response curves useful for design. (Author)

A81-45528 Fluid temperature control for parabolic trough solar collectors. R. Schindwolf (Sandia Laboratories, Albuquerque, NM). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 9 p. (WP3-D). 7 refs.

Techniques for controlling the temperature of the heat-transfer fluid in parabolic-trough solar-collector fields were studied by computer simulation. In particular, the rather stringent temperature-control requirements associated with thermal-electric power generation or cogeneration systems are addressed. Computer models representing the fluid temperature dynamics of the collectors and interconnecting piping were developed and integrated with dynamic models of control elements to obtain a closed-loop control-system simulation. A specific control configuration was chosen consisting of a flow-control valve and one or more temperature sensors to control the flow in each row of collectors. Various control algorithms were evaluated for stability and static errors; time responses to startup transients and to partial and full collector cloud-shadowing transients were obtained. The results indicated that the temperature-control requirements can be satisfied using readily available components. (Author)

A81-45586 A microcomputer based control system for solar parabolic collectors. G. Cammarata, A. Faro, G. Messina, and O. Mirabella (Catania, Università, Catania, Italy). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 6 p. (FP8-F). 6 refs.

A81-45587 Parameter estimation in solar systems by the method of least squares. D. Pryor, P. Burns, and C. B. Winn (Colorado State University, Fort Collins, CO). In: Joint Automatic Control Conference, San Francisco, CA, August 13-15, 1980, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 5 p. (FP8-H).

It is shown that the least squares method is able to compete with the Kalman filter method in all areas of solar systems parameter determination except convergence rate. The least squares method is, however, easier to implement than the Kalman filter method in that no initialization is called for and no statistical properties of the system inputs need be known beforehand. A possible drawback is that the method is not able to filter data; it is seen by inspection of the least squares equations that all data points are weighed equally in the determination of the solution. O.C.

A81-45598 Response of Schottky barrier solar cells at higher temperatures. S. Srivastava, N. K. Swami, and G. P. Srivastava (Birla Institute of Technology and Science, Pilani, India). *Journal of Physics D - Applied Physics*, vol. 14, Aug. 14, 1981, p. 1495-1503. 20 refs.

In the present work, the responses of Cu/Cr-p-type silicon and Au-n-type silicon Schottky barrier solar cells at higher temperatures have been studied. The variations of different factors, such as intrinsic carrier density, energy gap, absorption coefficient, barrier height, effective number of photons etc, have been taken into account. The results show that in the temperature range 300-450 K, except for the short-circuit current, all other factors (e.g., open-circuit voltage, fill factor and conversion efficiency) decrease with increase in temperature. (Author)

A81-46210 Interfacial phenomena in solar materials. L. E. Murr (Oregon Graduate Center, Beaverton, OR). *Solar Energy Materials*, vol. 5, June-July 1981, p. 1-19. 19 refs. Contract No. DE-FG04-79AL-10887.

This paper provides a short review of the fundamental features of the general classes of interfaces and interfacial thermodynamics. The energetics and structures of interfaces are reviewed in the context of applications of current understanding of interfacial phenomena to specific materials in several solar technologies. Overviews are presented for interfacial energetics, compositional and chemical analysis of interfaces, and the structure of interfaces and representative illustrations are provided. Numerous examples of interfacial phenomena pertinent to solar materials interface problems are included, and solar materials interface problems are discussed and summarized in a general way. Problems or concerns are tabulated for interfaces in specific solar systems or components, e.g., reflectors, polymers, absorbers, collectors, PV cells, storage systems and heat transfer materials. (Author)

A81-46211 Efficiency of Ge solar cells designed for Ge-GaAs bicolor systems. B. Sautreuil and A. Laugier (Lyon, Institut National des Sciences Appliquées, Villeurbanne, Rhône, France). *Solar Energy Materials*, vol. 5, June-July 1981, p. 21-36. 16 refs. Research supported by the Commissariat à l'Energie Solaire and Centre National de la Recherche Scientifique.

This paper presents the results of a detailed theoretical analysis of Ge solar cells designed for the two-cell Ge-GaAs system. Spectrum splitting and tandem stacked concepts are considered. The maximum intrinsic limit efficiency for the two concepts are 38 and 33 percent, respectively (300 K, 300 AM 1.5 suns). The analysis of the Ge cell, taking into account published data of minority carrier lifetimes versus doping level is made as a function of temperature, solar concentration ratio, series resistance and air mass number. The intrinsic parameters of the device, xj (junction depth) and surface recombination velocity are not critical if xj is less than 1 micron. Efficiencies of 13.5 percent for the Ge solar cell and 5.8 percent for the Ge cell with solar spectrum limited to 1.4 eV are obtained at 300 K 300 AM 1.5 suns. With the state-of-art GaAs solar cell, a realistic efficiency of 30 percent can be obtained for the two-cell system. V.L.

A81-46212 **Materials issues in solar thermal energy systems.** R. W. Mar and J. C. Swearengen (Sandia Laboratories, Livermore, CA). *Solar Energy Materials*, vol. 5, June-July 1981, p. 37-53. 28 refs.

The solar central receiver concept for the production of electrical energy or industrial process heat has been the subject of recent system and conceptual design studies. This paper explores the materials issues likely to be associated with the development of this technology. The scope of this paper is limited to concepts using nitrate salts as the heat transfer and energy storage media. Heliostat, fluid and containment materials are discussed with regard to system requirements, candidate materials, performance under simulated and field test experiments, and areas of future research. The emphasis is on materials which are the leading candidates for use in near-term systems. (Author)

A81-46213 **Physical background of spectral selectivity.** M. Sikkens (Groningen, Rijksuniversiteit, Groningen, Netherlands). *Solar Energy Materials*, vol. 5, June-July 1981, p. 55-70. 13 refs.

A discussion of the restraints imposed by fundamental physical relations on the performance of spectrally selective solar energy materials is presented. It is shown, that three different classes of selective materials can be distinguished. The limitations to the performance of each of these 'ideal' classes are indicated. Some examples of physical mechanisms leading to spectral selectivity are discussed. (Author)

A81-46215 **Phototransport parameters in InP single crystals.** L. Gouskov, C. Llinares, A. Brenac, and M. Savelli (Montpellier II, Université, Montpellier, France). *Solar Energy Materials*, vol. 5, June-July 1981, p. 81-94. 17 refs.

A determination of diffusion length (L) and surface recombination carrier velocity (s) is presented for single crystals of n- and p-type InP using electron-beam induced current profile and photoconductivity spectra measurements. The s parameter is evaluated for various chemical etches and crystalline orientations. A low s value is observed in n-type InP and this significant result confirms that InP is a good candidate for solar cells. V.L.

A81-46217 **Electrochemical solar cells with layer-type semiconductor anodes - Performance of n-MoS2 cells.** L. Fornarini, F. Stirpe, B. Scrosati (Roma, Università, Rome, Italy), and G. Razzini (Milano, Politecnico, Milan, Italy). *Solar Energy Materials*, vol. 5, June-July 1981, p. 107-114. 11 refs. Research supported by the Università di Roma.

A81-46333 **Calorimetric determinations of bond conductances in pipe and fin type flat-plate solar collectors.** H. P. Garg and U. Rani (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 9, Sept. 1981, p. 77-82. 8 refs.

A81-46387 **Phthalocyanine organic solar cells - Indium/x-metal free phthalocyanine Schottky barriers.** R. O. Loutfy, J. H. Sharp, C. K. Hsiao, and R. Ho (Xerox Research Centre of Canada, Mississauga, Ontario, Canada). *Journal of Applied Physics*, vol. 52, Aug. 1981, p. 5218-5230. 27 refs. Research supported by the National Research Council of Canada.

Operation characteristics of NESA/x-metal free phthalocyanine/indium photovoltaic devices are described, and a film of polycrystalline particles of x-metal free phthalocyanine (x-H2Pc) are shown to exhibit strong photovoltaic effects when sandwiched between tin oxide and indium electrodes. The active region responsible for electric power generation is confined to the metal/semiconductor interface. A Schottky barrier built-in potential of 0.63 V is estimated from C-V measurements, and at a peak solar power of 135 mW/sq cm, a power conversion efficiency of 1.2 percent is obtained. The effects of pigment loading, cell thickness, light intensity, binder material, dye sensitization and the nature of barrier electrodes are also studied. The devices exhibit open-circuit voltages of 0.45 V, and the concept is considered a viable approach to constructing simple, economical photovoltaic devices which are significantly more efficient than evaporated film, although engineering efficiency is low due to low transmission of light through the indium barrier electrode. D.L.G.

A81-46388 **The superposition principle for semiconductor-electrolyte junction solar cells.** F. El Guibaly and K. Colbow (Simon Fraser University, Vancouver, Canada). *Journal of Applied Physics*, vol. 52, Aug. 1981, p. 5247-5249. 9 refs.

The superposition principle of currents in a solar cell states that the current in an illuminated device subject to a forward bias voltage (V) is given by the algebraic sum of the short circuit photocurrent and the current (J) flowing at bias V in the dark. A mathematical analysis is given of this principle as applied to semiconductor-electrolyte solar cells. The surface transfer velocity and the density of photoexcitable surface states are shown to be important in determining the validity of the principle and the J-V characteristics of the device. Little error results when applying the principle to cells with long minority carrier diffusion length and passivated or low density of surface states; and results are applicable to Schottky-barrier solar cells. D.L.G.

A81-46391 **On the carrier collection efficiency of amorphous silicon hydride Schottky barrier solar cells - Effects of recombination.** D. Gutkowicz-Krusin (Exxon Research and Engineering Co., Theoretical Sciences Group, Linden, NJ). *Journal of Applied Physics*, vol. 52, Aug. 1981, p. 5370-5376. 9 refs.

Solutions for the photogenerated carrier densities and the carrier collection efficiency are found for amorphous silicon hydride, alpha-SiH(x), Schottky barrier solar cells. The dependence of the collection efficiency on the nature of the contacts and on four characteristic length scales is determined. Strong dependencies of collection efficiency on the width of the depletion region at very short wavelengths and on the hole diffusion length at long wavelengths suggests that the theory can be used to determine these parameters from measurements of collection efficiency in solar cells. For thin films, the agreement between calculated and measured collection efficiency is excellent, and the theory can be used to obtain quantitative information about hole diffusion length, and consequently the hole lifetime if the diffusion coefficient is known. D.L.G.

A81-46457 **Small Solar Power Systems /SSPS/.** W. Grasse (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Cologne, West Germany). *Sunworld*, vol. 5, May 1981, p. 68-72.

A detailed description is given of the project organization, hardware, and projected performance of the distributed collector and central receiver solar thermal research facilities comprising the Small Power Systems (SSPS) plants in Almeria, Spain. The Distributed Collector System (DCS) is rated at 500 kWe and employs two fields of line-focusing parabolic trough collectors. The Central Receiver System (CRS) has the same rating and uses liquid sodium as a heat-transfer medium to circulate the 530 C heat yielded by a concentration factor of 450 from 4000 sq m of reflective surface. The purpose of the plant's dual configuration is the comparison of the two concentration methods under identical environmental conditions and the responsibility of a single operator/evaluator. O.C.

A81-46458 * **Parabolic dish collectors - A solar option.** V. C. Truscello (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Sunworld*, vol. 5, May 1981, p. 80-86. Research supported by the U.S. Department of Energy and NASA.

A description is given of several parabolic-dish high temperature solar thermal systems currently undergoing performance trials. A single parabolic dish has the potential for generating 20 to 30 kW of electricity with fluid temperatures from 300 to 1650 C. Each dish is a complete power-producing unit, and may function either independently or as part of a group of linked modules. The two dish designs under consideration are of 11 and 12 meter diameters, yielding receiver operating temperatures of 925 and 815 C, respectively. The receiver designs described include (1) an organic working fluid (toluene) Rankine cycle engine; (2) a Brayton open cycle unit incorporating a hybrid combustion chamber and nozzle and a shaft-coupled permanent magnet alternator; and (3) a modified Stirling cycle device originally designed for automotive use. Also considered are thermal buffer energy storage and thermochemical transport and storage. O.C.

A81-46459 * **Parabolic dish systems at work - Applying the concepts.** A. T. Marriott (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Sunworld*, vol. 5, May 1981,

p. 86-89. Research supported by the U.S. Department of Energy and NASA.

An overview is given of parabolic dish solar concentrator application experiments being conducted by the U.S. Department of Energy. The 'engineering experiments' comprise the testing of (1) a small-community powerplant system, in conjunction with a grid-connected utility; (2) stand-alone applications at remote sites such as military installations, radar stations and villages; and (3) dish modules that can deliver heat for direct use in industrial processes. Applicability projections are based on a dish and receiver that use a Brayton engine with an engine/generator efficiency of 25% and a production level of up to 25,000 units per year. Analyses indicate that parabolic-dish power systems can potentially replace small, oil-fired power plants in all regions of the U.S. between 1985 and 1991. O.C.

A81-46469 New heat transfer factors for flat plate solar collectors. P. J. Lunde (Center for the Environment and Man, Inc., Hartford, CT). *Solar Energy*, vol. 27, no. 2, 1981, p. 109-113. 5 refs.

It is shown that, for flat plate collectors operating in economically viable applications, three equations presented give suitable heat transfer factors for collector efficiency equations based on inlet, mean, and outlet fluid temperatures, respectively. The equations can be solved explicitly for any variable and do not become indeterminate as the flow approaches infinity. In addition, simple equations can be derived with which to convert any efficiency curve to one based on an alternate fluid temperature if (1) the flow rate is known, and (2) curves based on a particular fluid and flow rate can be adjusted to another flow rate without additional information. When a new heat transfer fluid is used, the heat transfer coefficient changes and the new heat transfer factor can be derived from the known transmissivity-absorptivity product and absorber plate fin efficiency. O.C.

A81-46470 Heat degradation studies of solar heat transfer fluids. T. R. Henderson, C. R. Clark, T. C. Marshall, R. L. Hanson, and C. H. Hobbs (Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM). *Solar Energy*, vol. 27, no. 2, 1981, p. 121-128. 15 refs. Contract No. EY-76-C-04-1013.

A81-46471 Convex Fresnel lens with large grooves. E. M. Kritchman, A. A. Friesem, and G. Yekutieli (Weizman Institute of Science, Rehovot, Israel). *Solar Energy*, vol. 27, no. 2, 1981, p. 129-137. 29 refs.

Methods for the design of 'almost ideal' convex Fresnel lenses were extended to include lenses having grooves of finite size; where the choice of the groove size determines the best design. Emphasis is put on the case where a two-axis tracking solar system is represented. One of the resulting designs was found to yield a concentration factor of 34 almost independently of groove size, and to produce the highest concentration of all designs considered when the groove width/focal length ratio was equal to or greater than 0.023. The use of such relatively large grooves reduces the amount of radiation lost in blunt edges and from the diffraction of individual grooves. O.C.

A81-46502 Terrestrial solar energy systems - Test and evaluation. A. R. Lunde (Boeing Co., Seattle, WA). In: Life cycle problems and environmental technology; Proceedings of the Twenty-sixth Annual Technical Meeting, Philadelphia, PA, May 12-14, 1980. Mt. Prospect, IL, Institute of Environmental Sciences, 1980, p. 397-400.

The paper discusses various thermal-performance test and evaluation methods that are applied to solar collectors, such as flat-plate collectors, trough concentrators, parabolic concentrators, and central power-tower receivers. An indoor test facility for determining the thermal performance of solar collectors is described, along with the methods used to determine thermal performance and collection efficiency. The use of thermal models to evaluate materials, conceptual design, heat loss, and thermal efficiency is reviewed. The laser ray trace used to determine the surface contour accuracy of dish and trough concentrators is examined, and the facility's data acquisition system is outlined. F.G.M.

A81-46515 # Review, evaluation, and improvement of direct irradiance models. R. E. Bird and R. L. Hulstrom (Solar Energy Research Institute, Golden, CO). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Aug. 1981, p. 182-192. 50 refs.

A study was performed to: (1) define the relative significance of the various atmospheric constituents to the depletion of the direct solar beam irradiance; (2) compare and evaluate several simple models versus a complex SOLTRAN-model; and (3) develop an improved, easy to use model. The results indicate that for a reasonable range of atmospheric conditions the broadband direct beam energy is attenuated by atmospheric constituents in the following order: aerosols attenuate the most; molecular scattering is next in importance; and water vapor absorption is third. Attenuation by O3, O2, and CO2 is minor. The total irradiance from various models agree to within + or - 10 percent at small zenith angles, but diverge significantly at large zenith angles. (Author)

A81-46516 # The effect of receiver optical properties on solar thermal electric systems. P. J. Call, G. J. Jorgensen, and J. R. Pitts (Solar Energy Research Institute, Boulder, CO). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Aug. 1981, p. 207-212. 18 refs. Contract No. EG-77-C-01-4042.

The importance of reducing the thermal emittance of the receiver surface on the cost effective operation of intermediate and high temperature (not less than 400 C) solar thermal electric power plants is discussed. Computer codes for seven systems (point and line focus) are used to independently determine optimum operating conditions for selective (low emittance) and nonselective receiver surfaces. The detailed computer calculations show excellent agreement with numbers generated from a simplified analytical model indicating that system dynamics are a secondary effect in this sensitivity analysis. This study reveals that improvements in system cost effectiveness of 5 to 10 percent for desert environments can be produced by reducing receiver emittance from 0.95 to 0.3. The system operating temperature is determined not to be a critical parameter and little effect is observed on the system capacity factor. (Author)

A81-46518 # The interrelation between recurrent and capital costs in a solar thermal process heat system. L. L. Lukens and W. P. Schimmel, Jr. (Sandia Laboratories, Albuquerque, NM). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Aug. 1981, p. 241-243. 5 refs. Research supported by the U.S. Department of Energy.

The effect of operation and maintenance (O & M) costs on energy produced by solar collector systems is crucial to the market penetration of solar process heat as an alternative energy source. In the present paper, a particular O & M operation, regular collector cleaning, is considered in order to determine its effect upon annualized life cycle energy cost. A first-order model of mirror reflectance degradation as a function of time is constructed from experimental data. This is used as input to a systems optimization model of a line-focus solar collector process heat installation. The energy cost variation is considered as a function of cleaning cost per unit of collector aperture and cleaning interval. Results are presented for a process heat temperature of 177 C. (Author)

A81-46519 # Analytical dynamic modeling of line-focus solar collectors. J. D. Wright (Solar Energy Research Institute, Golden, CO). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Aug. 1981, p. 244-250. 8 refs.

Solar thermal electric power and industrial process heat systems may require a constant outlet temperature from the collector field. This constant temperature is most efficiently maintained by adjusting the circulating fluid flow rate. Successful tuning of analog or digital controllers requires a knowledge of system dynamics. Models relating deviations in outlet temperature to changes in inlet temperature, insolation, and fluid flow rate illustrate the basic responses and the distributed-parameter nature of line-focus collectors. When plotted in dimensionless form, the frequency response of a given collector is essentially independent of the operating conditions, suggesting that feedback controlled settings are directly related to such easily determined quantities as collector gain and fluid residence time. (Author)

A81-46520 # Theoretical and experimental study of an air solar collector with an evacuated tube cover. R. Alben and K. Hardcastle (General Electric Co., Schenectady, NY). *ASME, Trans-*

actions, Journal of Solar Energy Engineering, vol. 103, Aug. 1981, p. 251-257. 11 refs.

Theoretical calculations and experimental data on an evacuated tube solar collector with an air heat transfer medium are presented. The collector is a conventional flat plate design except that the front cover, instead of being made up of one or two sheets of flat glass, consists of a raft-like arrangement of evacuated glass tubes. The calculations indicate that an evacuated tube cover, together with a high heat transfer absorber, could give a solar collector with superior thermal performance. Experimental measurements are given for an air collector using uncoated evacuated tubes and a screen absorber. Results on internal temperatures are used to infer the effectiveness of the heat transfer between the absorber screen and the air flow. When account is taken of the measured absorber properties, the performance of the evacuated tube cover is in reasonable accord with the theory. (Author)

A81-46521 # Simulation of thermal performance of solar collector arrays. A. H. Fanney (National Bureau of Standards, Active Solar Systems Group, Washington, DC) and W. C. Thomas (Virginia Polytechnic Institute and State University, Blacksburg, VA). *(American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/SOL-1.) ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Aug. 1981, p. 258-267. 13 refs. Research sponsored by the U.S. Department of Energy.

A method is described for simulating the thermal performance of solar collectors by using an in-line heat source to simulate absorbed solar energy and a nonirradiated array to simulate heat losses, during tests of solar water heating systems. The mathematical relationships needed to operate an electric heat source in series with a nonirradiated array are developed, and consideration is given to the location of the heat source and arrays with collectors connected in parallel and series combinations. An analysis is presented of the effects on thermal performance of the mixed indoor-outdoor collector test procedures. Analytical and experimental results are presented which show that the net power output from a nonirradiated collector array in series with an electric heat source is in good agreement with that from an irradiated array. Location of the heat source downstream from the nonirradiated array results in closer agreement with the irradiated array thermal output as compared to locating the heat source upstream from the nonirradiated collector array. Results of tests of a domestic solar hot water system are consistent with the theoretical results. K.S.

A81-46522 # The role of rear insulation in the performance of flat plate solar collectors. S. Satcunanathan and P. Gandhidasan (University of the West Indies, St. Augustine, Trinidad and Tobago). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Aug. 1981, p. 282-284. 6 refs.

A81-47226 International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports (Internationales Sonnenforum, 3rd, Hamburg, West Germany, June 24-27, 1980, Tagungsberichte). Edited by H. Selzer (Deutsche Gesellschaft für Sonnenenergie, Bremen, West Germany). Munich, DGS-Sonnenenergie Verlags GmbH, 1980. 953 p. $39.50. In German and English.

Solar power systems are considered along with aspects of hydrogen technology, solar technology in sunny countries, wind energy, solar architecture, solar buildings, passive systems, the storage of energy, collector vests, legal aspects for solar systems, solar radiation, heat pump technology, and solar cooling. Attention is given to the practical use of solar technology, the layout of heliostat fields for solar thermal power stations, a comparison of solar tower plants with different cooling media, a 1-10 KWe solar power plant with modular cylindrical-parabolic concentrators, experience related to testing and operating concentrating collectors in small solar power plants, and economical aspects for large wind converters. Other subjects discussed are related to the construction and function of energy roofs, the efficiency of house heating in different climatic regions, principles of operation and design of energy-collecting roof systems, and an evaluation of Powersat. Other topics examined include hydrogen in large-scale solar energy utilization, the status and near term development goals of a hydrogen economy, and the storage of hydrogen by adsorption. G.R.

A81-47227 Eurelios - The 1 MW/el/ solar thermal power plant of the EEC (Eurelios - Das 1MW/el/ Sonnenkraftwerk der Europäischen Gemeinschaft). W. Palz, A. Strub, J. Gretz (Commission of the European Communities, Brussels, Belgium), H. Treiber, and J. Hofmann (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 3-20. 16 refs. In German.

Eurelios, the 1 MW(el) solar thermal power plant of the EEC, is a power tower plant. Its construction in Sicily is sponsored by the Federal Republic of Germany, France, and Italy. The employed technical concept involves the use of a water-cooled Francia-type cavity receiver and a heliostat field north of the tower. The heliostat field uses two types of heliostats. The energy produced by Eurelios will be delivered to the local grid. Attention is given to aspects of project organization and development, system requirements, system characteristics, energy balance data, details of heliostat design, aspects of receiver and tower construction, the thermal cycle, the thermal storage system, and the electrical system. G.R.

A81-47228 On-site versus centralized solar-electric systems (Solarelektrische Einzel- und Zentralsysteme im Vergleich). W. H. Thompson (San Diego State University, San Diego, CA). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 21-27. 9 refs.

Questions regarding solar energy in California are considered, taking into account the subsidy of solar installations by the State or the Federal government, and issues regarding the centralization or decentralization of solar systems. A centralized system would require a concentration of solar flux, while decentralization would permit the employment of low-priced photovoltaic panels, used without a concentrator, almost everywhere. The only other equipment besides a photovoltaic cell array the household would need would be some diodes to prevent the reversal of current, a voltage regulator, and a bank of batteries. If in the absence of an emergence of a more economical battery, lead-acid batteries had to be used, they would cost more than the solar cells. An alternative to using a large battery system is for the homeowner to become a seller of net energy to the power company. Attention is also given to the Space Satellite, the power tower, and the ocean thermal energy conversion unit. G.R.

A81-47229 The DCS solar power plant within IEA's SSPS project - Aspects of the final system layout and component selection (Das DCS-Sonnenkraftwerk in SSPS-Projekt der IEA - Gesichtspunkte der endgültigen Systemauslegung und der Komponentenwahl). A. C. Kalt (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Cologne, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 28-39. In German.

The SSPS project, which is financed by nine countries, has the objective to design, construct, and operate two solar power stations. The power stations will be located near Almeria in southern Spain. One of the two power stations utilizes the solar-tower principle, while the other represents a distributed collector system (DCS). In the DCS, the radiation energy is collected and transformed into heat with the aid of two collector fields, which operate in parallel. The heat is stored in a suitable medium. The heated medium can be stored in a tank. It is used to produce steam for the operation of a steam turbine, which is used to derive a three-phase generator. Attention is given to technical data, design criteria, the storage system, questions of collector selection, and the energy transformation system. G.R.

A81-47230 The layout of heliostat fields for solar thermal power stations (Die Auslegung von Heliostatfeldern für solarthermische Kraftwerke). V. Hartung, W. Meyer, and C. Kindermann (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 40-49. 5 refs. In German.

Solar thermal power stations which can provide power of 1 MW(el) and more can be optimally designed by making use of collectors based on the tower concept (heliostat). The description of

a heliostat field requires the use of a large number of parameters and a consideration of complex functional relations regarding these parameters. A system of computer programs has been developed for conducting the required calculations. The theoretical principles for the design of heliostat fields are presented and aspects of numerical processing are discussed. A description is given of two examples involving heliostat fields, taking into account Eurelios, a solar power station being built in Sicily and a power station which is currently in the planning and development stage. G.R.

A82-47231 Comparison of solar tower plants with different cooling media (Vergleich von Solar-Turm-Kraftwerken mit unterschiedlichen Kühlmedien). F. Boese, U. Leuchs, W. Meinecke, and D. Stahl (INTERATOM, Internationale Atomreaktorbau GmbH, Bergisch Gladbach, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 50-57. In German.

The characteristics of solar tower power stations are examined, taking into account the effect of these characteristics on the selection of the cooling medium. In connection with the high investment costs, a high efficiency regarding the entire system is more important than in the case of conventional power stations. An increase in the receiver costs of 5 percent can be quite acceptable, if it is accomplished by an enhancement of the system efficiency amounting to 5 percent. An optimum efficiency is obtained by minimizing the energy losses of the power station. Factors determining the selection of the cooling medium are related to conflicting objectives to obtain a high system efficiency on one side, and a long service life and a high level of availability for the receiver on the other. Cooling media considered in the comparison include sodium, gas, and water. G.R.

A81-47232 1-10 kWe solar power plant with modular cylindrical-parabolic concentrators of 100 sq m, oriented E-W. S. Petrescu, A. Danescu, and S. Bucurenciu (Bucuresti, Institutul Politehnic, Bucharest, Rumania). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 58-67. 16 refs.

A number of investigations have been conducted regarding the feasibility to design a solar power plant which employs cylindrical-parabolic concentrators. The subjects studied in the investigations are briefly considered and a description is presented of the current stage of development of such a plant. Attention is given to the solutions selected for the solar power plant to be implemented, taking into account the solar radiation collection system, the working fluid, the storage system, the thermal engine, the electric generator, and auxiliary services. The determination of the collection area, mounting system, and orientation system of the collectors is considered along with the sun-tracking system. It is found that the utilization of modular cylindrical-parabolic concentrators rotating about an E-W axis, flat receivers of concentrated radiation, and water as a working fluid leads to the best performance. G.R.

A81-47233 Experience related to testing and operating concentrating collectors in small solar power plants (Erfahrungen beim Test und Betrieb von konzentrierenden Kollektoren in Sonnenkleinkraftwerken). R. Köhne (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 68-77. 6 refs. In German.

Small-scale solar power stations with a power output in the range from ten to a few hundred KW are of particular interest for countries with a high level of insolation, particularly in the case of developing countries. The stations can provide electric power and process heat. A description is presented of four installations of the considered type. A heat-transfer fluid, such as water or oil, is heated in solar collectors to temperatures in the range from 150 to 290 C. The fluid is stored in a tank or pumped directly into a heat exchanger where the medium used for the operation of the heat engine is evaporated. This medium can be water or Freon. All four power stations use cylindrical-parabolic concentrators. Attention is given to the obtained levels of collector efficiency and the operational disturbances experienced. It was found that most failures occurred with conventional systems. However, there were also problems with collectors, which are mainly related to the entrance of dust. G.R.

A81-47234 Development and construction of ultra-light solar power stations (Entwicklung und Bau superleichter Sonnenkraftwerke). J. Kleinwächter and H. Kleinwächter (BOMIN-Solar GmbH, Lörrach, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 78-93. 9 refs. In German.

The concept of a solar power station of a novel type is compared with the concept of the conventional solar tower. The new concept makes use of large aerostatically deformed concentrators of very light weight. The concentrators, which consist of plastic films, are protected by being kept under transparent domes. The new approach makes it possible to improve important system parameter values compared to the values for the conventional design. These parameters include power-weight ratio and the required land-surface area. In addition, the severity of weather-related problems is significantly reduced. G.R.

A81-47239 Solar farm stations for industrial process heat (Solar Farm-Anlagen für industrielle Prozesswärme). U. Wiedman and G. Isenberg (M.A.N. - Neue Technologie, Munich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 232-242. In German.

The most obvious application for solar farms is the generation of heat, which can be offered at maximum efficiency rates of 50-60 percent in the temperature range from 150 to 300 C. In connection with efficiency considerations, concentrating collector systems must be employed for the envisaged applications. For process heat supplied at temperatures above 150 C, the solar farm stations can only be used in regions with a yearly solar radiation energy per unit area of more than 1300 KWh/sq m a. A description is presented of the design and performance range of solar farms employing the concentrating collector module Helioman. The market potential of the technology is discussed, taking into account a study regarding the process-heat requirements of prospective consumers as well as questions regarding the anticipated economic feasibility. G.R.

A81-47241 The modular evacuable nonimaging concentrating-collector concept (Modulares, evakuierbares, nicht abbildendes Konzentrator-Kollektorkonzept). T. Nordmann, Ch. Gloor, and H. U. Bogatzki (ELCO, Ltd., Vilters, Switzerland). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 253-262. 6 refs. In German.

The design and implementation of the modular evacuable nonimaging concentrating-collector are described. This concept features: (1) glass as the material of the collector body, assuring maximum life expectancy; (2) modular glass elements that allow the optimal adjustment to structural features due to individual collector size; (3) elements that are individually tilted towards the path of the sun; (4) low manufacturing cost due to existing production facilities in the glass and metal industries; and (5) good potential for development as a special insulating gas collector, low pressure collector, and hybrid thermal-electric collector. B.J.

A81-47245 Solar energy in Brazil (Sonnenenergie in Brasilien). P. Gräff. In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 354-361. In German.

In response to economic difficulties related to the high prices for oil, the Brazilian government has sponsored a program, which has the objective to use in 1985 alcohol for 20 percent of the fuel needed for the operation of automobiles. The program also demonstrates the magnitude of the solar potential of Brazil. Various possibilities of solar utilization are discussed. Collectors of solar energy are considered, taking into account aspects of storage, the use of solar energy for drying applications in agriculture, the replacement of fans by solar collector systems which provide air currents, solar hot-water supply systems for high buildings, effects on national economy, and ecological aspects. Attention is given to the alcohol

program, the biopotential, biogas, the use of pyrolysis, the utilization of water hyacinth plants for biogasification, and ecological aspects. G.R.

A81-47254 Complete electrical power supply for small loads at remote sites with wind and solar energy (Elektrische Vollversorgung von abgelegenen Kleinverbrauchern mit Wind- und Sonnenenergie). F. Auer (Battelle-Institut, Frankfurt am Main, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 481-490. 6 refs. In German.

The combined use of wind and solar energy to supply solar electrical loads at remote sites will be of increasing importance in the near future. A computer program has been developed which can calculate for every site and for arbitrary loads a cost minimum for the wind energy converter and solar cells in conjunction with a battery storage unit. A plant thus optimized can provide a complete electrical power supply, e.g., for TV transmitters or weekend houses. B.J.

A81-47258 Standardized test procedures for solar collectors - Evaluation, status, and trends. H. D. Talarek and H. J. Stein (Kernforschungsanlage Jülich GmbH, Institut für Kernphysik, Jülich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 711-721. 13 refs.

It is noted that through round-robin testing of flat-plate collectors, the inherent uncertainties of test procedures in use become apparent. It is found that well-calibrated pyranometers and an integral calorimetric calibration of the test facility can markedly increase the accuracy of measurements. The range of variation for the environmental parameters allowed by the procedures is modeled and compared with experimental data. C.R.

A81-47259 A collector test method suitable to Swiss weather conditions. J. M. Suter, J. Keller, P. Kesselring, and F. Widder (Eidgenössische Technische Hochschule, Zürich, Wurenlingen, Switzerland). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 722-730. 5 refs.

A method for outdoor testing of solar collectors under covered and clear sky conditions in Switzerland is presented. Statistical averages are determined for three collector parameters, the thermal loss coefficient, and the optical efficiency for pure diffuse radiation and pure direct radiation. The gross heat output delivered monthly by the collector is calculated in a given climate under standard conditions, and tables are produced which give the average monthly efficiency. Forty hot water collectors are tested, and a spectral analysis of the different glass covers and absorbers used in the tests indicate that the transmission of the covers depends strongly on the origin of the glass. Test results from 1978 to 1979 show that points are spread over a large domain, so that a 10% variation in optical efficiency may induce a 20% variation in the yearly gross heat output of the collector. D.L.G.

A81-47260 Correlation studies of the intensities of direct and diffuse radiation (Korrelationsuntersuchungen der Intensitäten der direkten und der diffusen Strahlung). K. R. Schreitmüller (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Technische Physik, Stuttgart, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 755-764. 7 refs. In German.

A model of atmospheric scattering and absorption processes is used to study the ratio of diffuse to total radiation, an essential criterion for the design of solar energy systems. It is shown that, for the assumptions used, this ratio is independent of local concentration variations of the scattering particles in the vertical direction. The computed and measured correlation curves agree well if an increasing number of Mie-scattering particles with increasing turbidity is assumed. Statistical studies and indoor experiments confirm the calculated dependence of the shape of the correlation curves on the solar altitude. B.J.

A81-47422 Environmental enhancement of the oceans by increased solar radiation from space. J. Klassi (Expedition Earth, Inc., Los Angeles, CA). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-243.* 10 p.

This paper explains how increased solar radiation from Space Light systems can enhance Ocean Thermal Energy Conversion (OTEC), ocean kelp farming, sea-food production and rejuvenation of polluted oceans. Space Light Reflectors focused on OTEC sites can enhance ocean thermal energy conversion by increasing the temperature difference between sun-warmed surface waters and the cold ocean depths. Focused on kelp farms, Space Light Reflectors can enhance methane production by providing optimal sunlight for maximum kelp yield. In conjunction with nutrient-rich water from ocean Upwelling Pipes, Space Light can stimulate the growth of phytoplankton on which commercially valuable fish feed. Efficient integration of these space and ocean systems can produce energy and restore life to polluted oceans. (Author)

A81-47501 Solar jubilee - 25 years of the sun at work; Proceedings of the Annual Meeting, Phoenix, AZ, June 2-6, 1980. Volumes 3.1 & 3.2. Meeting sponsored by ISES, Arizona Solar Energy Association, SERI, et al. Edited by G. E. Franta and B. H. Glenn (Solar Energy Research Institute, Golden, CO). Newark, DE, International Solar Energy Society, 1981. Vol. 3.1, 700 p.; vol. 3.2, 850 p. Price of two volumes, $125.

Among the topics discussed are the agricultural and industrial applications of solar energy, greenhouses, the biological and chemical conversion of biomass, energy plantations, thermochemical conversion of biomass, domestic water heating systems, active solar cooling, combined active solar heating and cooling, thermal energy storage for solar heating systems, design methods for active solar heating, combined solar heat pump systems, solar ponds, low temperature collector design and testing, solar concentrator test facilities, line focus concentrator components, small solar power systems, point focus concentrator components and central receiver conceptual design studies, and low concentration collectors. Also considered are passive solar systems, architectural synthesis of passive solar elements, case studies in passive heating and cooling, the modeling and measurement of passive systems, passive solar heating techniques and components, photovoltaic device technology, applications of photovoltaics, flat plate and concentrator photovoltaic system design, environmental testing and performance evaluation of photovoltaic systems, selective surfaces and radiative properties, cost/performance relationships in the photovoltaic design process, the economics of residential solar applications, solar device marketing, policies for energy decentralization, solar energy organizations, solar radiation, wind resource assessment and siting, dispersed and large scale wind system applications, and general problems in wind energy utilization. O.C.

A81-47505 Agricultural energy; National Energy Symposium, Kansas City, MO, September 29-October 1, 1980, Selected Papers. Volume 1 - Solar energy livestock production. Volume 2 - Biomass energy crop production. Volume 3 - Food processing. Symposium sponsored by the American Society of Agricultural Engineers, U.S. Department of Energy, U.S. Department of Agriculture, et al. St. Joseph, MI, American Society of Agricultural Engineers, 1981. Vol. 1, 282 p.; vol. 2, 314 p.; vol. 3, 96 p. Price of three volumes, members, $39.50; nonmembers, $49.50.

Among the topics covered are solar grain drying, solar collector design, construction and evaluation, applications of greenhouse solar systems, solar space heating for livestock buildings, solar heat pumps, wind energy for agricultural heating systems, the application of solar energy to the raising of poultry, microcomputer control of environmental systems, and solar cooling. Also discussed are corncob gasification, ethyl alcohol fuel production, corn-residue harvesting systems, agricultural residue furnaces, agricultural produce-derived diesel fuel substitutes, machine energy requirements, the use of wind energy for refrigeration and irrigation pumping, greenhouse design and performance, and irrigation pumping efficiency. Attention is also given to the use of solar energy in such food-processing operations as drying, canning, pasteurization, milling and kilning. O.C.

A81-47593 # Development and design of the flexible solar cell sheet for the space project Space Telescope (Entwicklung und

Auslegung des flexiblen Solarzellen-Lakens für das Raumfahrtprojekt Space Telescope). J. Koch (Telefunken AG, Wedel, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-081.* 12 p. 6 refs. In German.

Space Telescope (ST) represents a joint project of NASA and ESA. A telescope will be placed by the Shuttle in orbit at an altitude of approximately 500 km. After completion of its observational program (maximum 5 years), the telescope will be brought back to earth. Important components of the Space Telescope will be developed and manufactured in Europe. The solar generator will be manufactured by a British aerospace company. A German company is responsible for development and delivery of the subsystem containing the solar cell sheet. Every ST solar generator consists of four flexible solar cell sheets. Every solar cell sheet contains 5 Solar Panel Assembly (SPA) units. Attention is given to SPA design, the conduction of the development work, the development models, the material specifications, and manufacturing plans. G.R.

A81-47598 # Light construction elements from CFK for satellite solar generators of different size (Leichtbaustrukturen aus CFK für Satellitensolargeneratoren verschiedener Grösse). H. Bansemir and W. Buchs (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-080.* 25 p. 7 refs. In German.

Based on typical satellite systems, the structural principles of three types of solar generators are presented: a fixed solar generator for research satellites, an expandable solar generator with sandwich panels for station to station broadcasting satellites, and an expandable solar generator with frames and prestressed membranes for direct transmitting radio and television broadcasting. The requirements of the various generators and their construction materials are used to develop the typical structure elements. The different elements used in power conducting and connection, such as the bearing joints, the loops, and the inserts are considered with respect to their construction and use. The stability behavior of the sandwich panel mountings as well as their thermal requirements are discussed in detail. Schematics and charts are included. J.F.

A81-47681 Optimized second stage concentrator. E. Kritchman (Chicago, University, Chicago, IL). *Applied Optics,* vol. 20, Sept. 1, 1981, p. 2929-2933. 5 refs. Contract No. DE-FG02-79ET-00089.

The incorporation of a second-stage trumpetlike reflective element at the focal plane of a paraboloidal dish reflector is analyzed to examine the improvement in solar concentration capability. The optimally adapted trumpet compensates for the optical aberrations of the dish and for large f/nos. The consequent concentration capability is comparable to the ideal. (Author)

A81-47682 Luminescent solar concentrators and the reabsorption problem. R. W. Olson, R. F. Loring, and M. D. Fayer (Stanford University, Stanford, CA). *Applied Optics,* vol. 20, Sept. 1, 1981, p. 2934-2940. 12 refs. Research supported by the Petroleum Research Fund; NSF Grant No. DMR-79-20380.

The problem of reabsorption in luminescent solar concentrators (LSC) is discussed. A mathematical development is presented which enables the LSC gain to be calculated based on the optical properties of the materials and a random walk formalism. Two- and three-dimensional analyses are used. A detailed set of calculations for a common dye (rhodamine 6G) is used to examine the practicality of employing a single dye. The effects of diameter, thickness, and quantum yield on the LSC output are presented. The spectrum of the LSC output as a function of concentration is calculated. It is suggested that LSCs can be made more efficient with a system which utilizes radiationless electronic excited state transport and trapping as intermediate steps between absorption and reemission. Trap emission substantially avoids the reabsorption problem. (Author)

A81-47683 Fresnel lens analysis for solar energy applications. E. Lorenzo and A. Luque (Madrid, Universidad Politécnica, Madrid, Spain). *Applied Optics,* vol. 20, Sept. 1, 1981, p. 2941-2945. 10 refs. Research sponsored by the Ministerio de Industria y Energía.

An arbitrarily shaped, lineal Fresnel lens is analyzed in two roles: (1) that of a sole concentration stage, and (2) that of the first stage in a two-stage concentration system in which the second stage considers the first as a Lambertian source. Gain and lens position are determined for all possible configurations, and it is demonstrated that a curved lens with a refractive index approaching infinity and with a given profile is an ideal concentrator. O.C.

A81-47837 Semiconductor device development in the 1970's and 1980's - A perspective. S. M. Sze (Bell Telephone Laboratories, Inc., Murray Hill, NJ). *IEEE, Proceedings,* vol. 69, Sept. 1981, p. 1121-1131. 20 refs.

In the 1970s more than 40,000 papers were published on semiconductor devices, with numerous breakthroughs in device concept and performance. The papers were grouped into four main categories: bipolar, unipolar, microwave, and photonic. Unipolar development expanded most rapidly in the 1970s, followed by photonic devices. Bipolar development expanded at a slower rate, and microwave development declined, indicative of its reaching a mature stage. New developments in bipolar and unipolar devices include oxide-isolated bipolar transistors, I2L power thyristors, submicrometer MOSFETs, laser-processed silicon-insulator devices, nonvolatile memories, and CCDs. It appears that the minimum feature length of these devices will continue to shrink, and new device configurations will minimize parasitics and power dissipation. New microwave devices include the high-efficiency IMPATT, permeable-base transistors, and MESFETs; it is expected that the gap between the present upper limit of microwave frequency (approximately 100 GHz) and the lower limit of infrared (approximately 1000 GHz) will be narrowed or eliminated. Isotype and anisotype heterojunctions will be used in photonic devices and superlattice structures. Devices discussed in this area include the quaternary laser, avalanche photodetectors, and concentrator and thin-film solar cells. J.F.

A81-47978 Advances in computer technology - 1980. Volume 1 - Proceedings of the International Computer Technology Conference, San Francisco, CA, August 12-15, 1980. Conference sponsored by the American Society of Mechanical Engineers. Edited by A. Seireg (Wisconsin, University, Madison, WI). New York, American Society of Mechanical Engineers, 1980. 476 p. $60.

Topics discussed include computers in energy systems, robots and manipulators, computing systems and mini - micro systems, and CAD systems. Papers are presented on the optimization for digital governors and digital automatic voltage regulators used in power systems, on a programmable flexible assembly system with an industrial robot, on models and metrics for software management and engineering, and on the proper role of interactive language in computer aided design. Attention is also given to flux distribution on a solar central receiver, to kinesthetic coupling between operator and remote manipulator, to the automatic generation of dynamics equations by computer, and to an implementable algorithm for computer-aided design problems with or without dynamic constraints. C.R.

A81-47980 # Computer simulation of solar collector temperatures under stagnation conditions. I. T. Hwang, P. Y. Wang, and P. S. Chopra (Argonne National Laboratory, Argonne, IL). In: Advances in computer technology - 1980. Volume 1 - Proceedings of the International Computer Technology Conference, San Francisco, CA, August 12-15, 1980. New York, American Society of Mechanical Engineers, 1980, p. 61-66. 6 refs. Research sponsored by the U.S. Department of Energy.

The absorber plate of an inactive solar collector can reach very high temperatures (greater than 230 C). Then, when the relatively cool heat transfer liquid is pumped through the collector, a steep temperature gradient develops that imposes severe thermal stress on the plate. To evaluate plate deformation and thermal stress, it is essential to have a thorough understanding of the relationship between changes in the plate temperature, changes in the fluid temperatures, and changes in the intensity of solar insolation. This paper presents the temperature responses that were calculated using the IBM Continuous System Modeling Program III (CSMP III). (Author)

A81-48024 # Measurement of flat-plate collector heat loss coefficients. N. M. Nahar (Central Arid Zone Research Institute,

Jodhpur, India). *Regional Journal of Energy, Heat and Mass Transfer*, vol. 3, Apr. 1981, p. 123-133. 12 refs.

An indoor method for direct measurement of the overall heat loss coefficient is developed so that solar energy can be more efficiently trapped by optimized flat-plate solar collectors. A schematic diagram of the indoor test set-up is given, with liquid temperature controlled by an electrical contact thermometer, and relay circulated by a pump to maintain a constant flow rate. The overall heat loss coefficient is measured in a bond duct type collector with single and double glazings, and is found to vary from 3.5 to 4.7 per sq Wm-K with zero wind speed. The coefficient is also reported for controlled wind speeds, and heat losses are found to increase by 13.5 and 7.5% for single and double glazed collectors respectively. The coefficient is presented as a function of plate temperature, and results are compared with calculated values, demonstrating good agreement. D.L.G.

A81-48108 678-mV open-circuit voltage silicon solar cells. A. W. Blakers and M. A. Green (New South Wales, University, Kensington, Australia). *Applied Physics Letters*, vol. 39, Sept. 15, 1981, p. 483-485. 18 refs. Research supported by the National Energy Research, Development and Demonstration Council of Australia.

A new high-performance cell structure has been developed, combining the better features of metal insulator semiconductor and p-n junction technologies. The metal-insulator-NP junction (MINP) cell technology described has an inherently superior performance to either of its constituent technologies, producing open-circuit voltages up to 678 mV (AMO, 25 C) for silicon cells. Analysis of the dark saturation current of MINP devices as a function of bulk resistivity indicates that both bulk and surface recombination contribute to this current, with the former dominating. Prospects for exceeding 700-mV open-circuit voltage with this approach are discussed. The structure is particularly well suited for fabrication using ion implantation. (Author)

A81-48144 Solar ponds. H. Tabor (Scientific Research Foundation, Jerusalem, Israel). *Solar Energy*, vol. 27, no. 3, 1981, p. 181-194. 45 refs.

The history and current status of salt-gradient non-convecting solar ponds are presented. These ponds are large-area collectors, capable of providing low-cost thermal, mechanical, or electrical energy using low-temperature turbo-generators. The basic theory of salt-gradient solar ponds is sketched; the effects of wind, leakage, and fouling and their constraints on location selection for solar ponds are discussed. The methods of building and filling the ponds, as well as extracting heat from them are explained in detail. Practical operating temperatures of 90 C can be obtained with collection efficiencies between 15% and 25%, demonstrating the practical use of the ponds for heating and cooling purposes, power production, and desalination. A condensed account of solar pond experience in several countries is given. This includes the 150 kW solar pond power station (SPPS) operating in Israel since December, 1979 and a 5000 kW unit currently under development. A study of the economics involved in using the ponds is presented: despite a low conversion efficiency, the SPPS is shown to have applications in many countries. J.F.

A81-48145 An analysis of the non-convecting solar pond. M. N. A. Hawlader and P. J. Brinkworth (University College, Cardiff, Wales). *Solar Energy*, vol. 27, no. 3, 1981, p. 195-204. 26 refs. Research supported by the Science Research Council of England.

The thermal behavior of the non-convecting solar pond is examined by numerically solving dynamic equations of radiation absorption and heat loss. The analysis incorporates hourly meteorological data from a site in southern England. Temperature histories for the first years of operation are given, showing the influence of the leading physical characteristics of the pond. Pond temperatures are shown to be strongly dependent on the effective extinction coefficient for solar radiation and the thermal losses from the pond bottom. The temperature history approaches a quasi-steady form within two to three years of operation, depending on the load demand. It is shown that modest loads (around 10% of the average insolation) can be used in this climate at temperatures appropriate for practical application. Performance estimates from this study are compared with earlier estimates, providing a pointer to potential solar pond performance in other high-latitude maritime climates. J.F.

A81-48147 Yearly average performance of the principal solar collector types. A. Rabl (Solar Energy Research Institute, Golden, CO). *Solar Energy*, vol. 27, no. 3, 1981, p. 215-233. 33 refs.

The results of hour-by-hour computer calculations for 26 U.S. meteorological stations are used to derive universal correlations for the yearly total energy that can be delivered by various solar collector types: flat plates, evacuated tubes, CPC, collectors that track about one axis, collectors that track about two axes, and central receivers. The correlations, polynomials of first and second order in yearly average insolation, latitude, and threshold, are used to find the yearly collectible energy by reading a single graph and multiplying the coordinates by the collector parameters. The method is shown to reproduce the results of the computer calculations with an accuracy of 2% for flat plates and 2-4% for concentrators. The method can be applied to photovoltaic systems, solar-augmented industrial process heat systems, or solar thermal power systems; it can also be used to rate collectors on the basis of yearly average performance or to evaluate the effects of collector degradation, the benefits of collector cleaning, and the gains from collector improvements. J.F.

A81-48175 * Solar energy. D. Rapp (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA; Texas, University, Richardson, TX). Englewood Cliffs, NJ, Prentice-Hall, Inc., 1981. 527 p. 103 refs. $32.

The book opens with a review of the patterns of energy use and resources in the United States, and an exploration of the potential of solar energy to supply some of this energy in the future. This is followed by background material on solar geometry, solar intensities, flat plate collectors, and economics. Detailed attention is then given to a variety of solar units and systems, including domestic hot water systems, space heating systems, solar-assisted heat pumps, intermediate temperature collectors, space heating/cooling systems, concentrating collectors for high temperatures, storage systems, and solar total energy systems. Finally, rights to solar access are discussed. B.J.

A81-48188 # Si MIS solar cells by anodization. J. Nanjo, H. Yamamoto, and H. Hasegawa. *Hokkaido University, Faculty of Engineering, Bulletin*, July 1981, p. 65-73. 9 refs. In Japanese, with abstract in English.

The formation of thin insulating layers by anodic oxidation has been investigated as an alternative way of fabricating low-cost silicon MIS solar cells. Anodizing has been carried out both under constant voltage and constant current conditions in an ethylene glycol solution of KNO3. It is found that in both cases the open-circuit voltage increases without a reduction in the short-circuit current, but the constant-voltage process is easier to control and is characterized by better reproducibility than the constant-current process. A maximum open-circuit voltage of 0.52 V, as compared with 0.37 V for the Schottky cell, has been achieved in the constant-voltage mode at 0.5 V. V.L.

A81-48365 Back-up electrical power needs for residential solar water heaters. B. L. Capehart and M. R. Peabody (Florida, University, Gainesville, FL). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 473-477.

A81-48471 A new method for the measurement of series resistance of solar cells. S. K. Agarwal, R. Muralidharan, S. C. Jain (Solid State Physics Laboratory, Delhi, India), A. Agarwala, and V. K. Tewary (Birla Institute of Technology and Science, Pilani, India). *Journal of Physics D - Applied Physics*, vol. 14, Sept. 14, 1981, p. 1643-1646. 5 refs.

A method is proposed for measuring the series resistance of solar cells based on the observed nonlinearity in the short-circuit current-light intensity relation. It is shown that the nonlinearity is a manifestation of the effects of series resistance, which can thus be determined from the slope of a plot of the natural logarithm of the difference between the light-generated current and the short-circuit current against the short-circuit current. The method is illustrated in a study of space-quality n(+)p Si solar cells under AMO simulation at various distances from the light source, where the light-generated current is determined from a linear extrapolation of the relation of short-circuit current to illumination intensity. Comparison with three previous methods for determination of the series resistance (the

illuminated curve method, the p-n junction-dark forward characteristic method and the method of Rajkanan and Shewchum (1979)) reveals the present method to be faster and more accurate, requiring the measurement of a single parameter as a function of light intensity. A.L.W.

A81-48472 Depth profile composition studies of thin film CdS:Cu2S solar cells using XPS and AES. V. G. Bhide, S. Salkalachen, A. C. Rastogi (National Physical Laboratory of India, New Delhi, India), C. N. R. Rao, and M. S. Hegde (Indian Institute of Science, Bangalore, India). *Journal of Physics D - Applied Physics*, vol. 14, Sept. 14, 1981, p. 1647-1656. 29 refs. Research sponsored by the Tata Energy Research Institute.

Studies of the surface composition and depth profiles of thin film CdS:Cu2S solar cells based on the techniques of X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES) are reported. Specimens were fabricated by the thermal deposition of polycrystalline CdS films onto silver-backed electrodes predeposited on window glass substrates, followed by texturization in hot HCl and chemical plating in a hot CuCl(I) bath for a few seconds to achieve the topotaxial growth of CuS films. The XPS and AES studies indicate the junction to be fairly diffused in the as-prepared cell, with heat treatment in air at 210 C sharpening the junction, improving the stoichiometry of the Cu2S layer and thus improving cell performance. The top copper sulfide layer is found to contain impurities such as Cd, Cl, O and C, which may be removed by mild Ar(+) ion beam etching. The presence of copper deep in the junction is invariably detected, apparently in the grain boundary region in the form of CuS or Cu(2+) trapped in the lattice. It is also noted that the nominal valence state of copper changes abruptly from Cu(+) to Cu(2+) across the junction. A.L.W.

A81-48475 Ion implanted polycrystalline silicon solar cells. L. D. Nielsen (Danmarks Tekniske Hojskole, Lyngby, Denmark). *Physica Scripta*, vol. 24, Aug. 1981, p. 390, 391.

Polycrystalline silicon pn-junction solar cells have been prepared by ion implantation. Results are presented for cells based on wafers of a large-grained vapor-phase-grown material. Enhanced UV-sensitivity has been demonstrated, and AM1 efficiencies of 11% have been obtained without an optimized antireflective coating. (Author)

A81-48492 Improved mobility in OM-VPE-grown Ga/1-x/In/x/As. W. T. Dietze, M. J. Ludowise, and C. B. Cooper (Varian Associates Solid State Laboratory, Palo Alto, CA). *Electronics Letters*, vol. 17, Sept. 17, 1981, p. 698, 699. 11 refs. Contract No. XP9-8081-1.

A method is proposed for improving the quality of Ga(1-x)In(x)As grown by organometallic vapor phase epitaxy, a process especially attractive for the large volume production of solar cells. The proposed improvement involves the use of a trimethylindium-trimethylarsenic adduct, synthesized in the gas phase, as the In source, and AsH3 as the primary As source. The improved epitaxial layers have higher mobilities and lower background doping levels compared to layers grown with trimethylarsenic as the sole As source. V.L.

A81-48561 A potential show stopper. J. E. Drummond (Power Conversion Technology, Inc., San Diego, CA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record.

New York, Institute of Electrical and Electronics Engineers, 1980, p. 415-420. 10 refs. Contract No. DE-AC03-79ER-10341.

The effects of thermal self-focusing instability on radio-wave power transmission in the SPS program are examined. It is found that, without lowering the power per beam, orbital radius, or operating wavelength of solar power satellites, the thermal self-focusing, fluctuation-amplifying instability will be excited in the F-region during at least some periods of the sunspot cycle. This instability could result in a significant phase disruption of both the guidance beam and power beam. Raising the operating frequency of the power beam from 2.45 GHz to 4 GHz would eliminate the instability as a significant effect on beam quality even at the highest power contemplated, 10 GW. Furthermore, lowering and reorienting the orbits to sun-synchronous, iso-insolation orbits would severely limit the growth of the self-focusing instability and reduce the required rectenna area by about a factor of 10 and eliminate the need for the large universal joint on the antenna. B.J.

A81-48933 A generalised approach to lifetime measurement in pn junction solar cells. S. R. Dhariwal and N. K. Vasu (Government College, Ajmer, India). *Solid-State Electronics*, vol. 24, Oct. 1981, p. 915-927. 21 refs.

In the recent years a number of new methods have been proposed and earlier methods reviewed for the measurement of minority carrier lifetime in solar cells. These include the open circuit voltage decay, reverse recovery, photoconductivity decay, spectral response, short circuit capacitance measurement, impedance measurement, light-induced photovoltaic decay and open circuit to short circuit switching methods. This paper presents a common mathematical formulation from which results for all these methods can be obtained. This enables one to compare the relative merits of these methods. (Author)

A81-48949 Heterogeneous photocatalytic oxidation of aromatic compounds on TiO2. M. Fujihira, Y. Satoh, and T. Osa (Tohoku University, Sendai, Japan). *Nature*, vol. 293, Sept. 17, 1981, p. 206-208. 31 refs.

The photocatalytic oxidation of aromatic compounds by means of H2O2 produced on TiO2 powders is investigated as a possible means for the efficient utilization of solar energy. The process investigated involves the generation of H2O2 in water from photo-induced electrons and holes in the conduction and valence bands of the TiO2 catalyst, which then decomposes into the hydroxyl radical and hydroxide anion by the Fenton reaction. When TiO2 photocatalyst in a mixture of water and an organic substrate was illuminated by a 500-W Xe lamp or 500-W high-pressure mercury arc lamp in air, analysis of the product revealed that every aromatic compound (benzene, toluene and acetophenone) was hydroxylated to produce the corresponding phenol, as well as biphenyl from benzene, benzaldehyde from toluene, and phenol from acetophenone. Yields of the organic products can be improved by regulating the pH of the system and by the addition of catalysts for hydroxyl radical formation, resulting in quantum yields as high as 1-5%. A.L.W.

A81-49242 Fluorescent planar collector-concentrators - A review. A. Goetzberger and V. Wittwer (Fraunhofer-Gesellschaft, Arbeitsgruppe für solare Energiesysteme, Freiburg im Breisgau, West Germany). *Solar Cells*, vol. 4, Aug. 1981, p. 3-23. 19 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4190-A.

Fluorescent planar collector-concentrators are a new concept for the conversion of solar energy into electrical and thermal energy. The main advantages of this concept are the concentration of direct light and the collection of diffuse light with inexpensive large-area collectors and small-area solar cells. In combination with photovoltaic cells, this type of collector offers the advantage of separating the various wavelengths of light and converting them using solar cells with different band gaps. This paper reviews such systems, with emphasis on theoretical models, efficiency, collector properties, and experimental results. B.J.

A81-49243 Conversion of solar radiation by fluorescence - Application to the encapsulation of cells (Transformation du rayonnement solaire par fluorese - Application à l'encapsulation des cellules). D. Sarti, F. Le Poull, and P. Gravisse (Laboratorie Bric, Croissy-sur-Seine, Yvelines, France). *Solar Cells*, vol. 4, Aug. 1981, p. 25-35. 11 refs. In French. Ministère de l'Industrie Contract No. 293,694.

A cost-effective approach to the encapsulation of solar cells is presented. The presence of fluorescent substances, associated with a cascade of light in the polymethylmethacrylate (PMMA) resin, encasing the silicon solar cells, resulted in a 25 percent increase in the conversion efficiency of photovoltaic modules. The support (Altuglas 1710) on which the solar cells are placed was also shown to play a significant role in the process. This improvement is a result of (1) a better spectral match between the incident radiation and the solar cell sensitivity and (2) a concentration of radiation due to the total internal reflections in the PMMA matrix. J.F.

A81-49244 High efficiency silicon cells for luminescent solar concentrators. C. M. Garner, F. W. Sexton, and R. D. Nasby (Sandia Laboratories, Albuquerque, NM). *Solar Cells*, vol. 4, Aug. 1981, p. 37-46. 12 refs. Research supported by the U.S. Department of Energy.

Energy conversion efficiencies of 18% and 19.4% at 0.1 W/sq cm and 1 W/sq cm, respectively, were measured for a luminescent solar concentrator cell under an air mass of one solar spectrum. This cell was designed for operation under illumination of 600 nm wavelength and 1 W/sq cm. From these results and spectral response data, an efficiency of 26% can be projected for illumination at 600 nm. This agrees well with computer code calculations of 28%. The substrate doping level, cell grid pattern, minority carrier lifetime and anti-reflection coating properties were studied to optimize the cell performance for 600 nm and longer wavelengths. (Author)

A81-49245 The silicon concentrator photovoltaic generator Sophocles - Performance and costs based on material characteristics. D. Esteve, G. Vialaret, and F. Therez (CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes, Toulouse, France). *Solar Cells*, vol. 4, Aug. 1981, p. 47-59. 11 refs.

The purpose of this paper is to show that, in the short term, a solution can be found to enable the immediate exploitation of concentrator photovoltaic systems. The technical requirements, tracking system, optical system and thermal dissipation necessary for concentrator generators are described. A description of the prototype generator 'Sophocles' is presented. The results of various experiments are given. Finally, the prospects of reductions in cost for a concentrator generator using a higher concentration ratio and more efficient solar cells, which can lead to a price of $4/W(p) if all expenses are taken into account, are reviewed. (Author)

A81-49246 Autonomous photovoltaic converter with linear focusing concentrator. J. P. David, F. Floret, J. Guerin, J. C. Paiva, and L. Aiache (Aix-Marseille I, Université, Marseille, France). *Solar Cells*, vol. 4, Aug. 1981, p. 61-70. 7 refs. Research supported by the Commissariat à l'Energie Solaire; Délégation Générale à la Recherche Scientifique et Technique Contract No. 78-7-0052.

An autonomous photovoltaic converter with a linear focusing concentrator allowing an effective concentration gain of 20 was designed, realized and tested. The photocells are special silicon cells; their cooling system is passive. The concentrator is a Fresnel-type segmented mirror. Part of the electrical power supplied by the device is used in its own sun-tracking system, the other part charges a 12 V, 30 A h, lead battery and the energy so stored during the day is used at night to light a room by a neon tube. The realization and performance of this prototype converter are described. Although cost estimation does not seem meaningful, further developments of such modules are discussed. (Author)

A81-49247 Study of and tests on a hybrid photovoltaic-thermal collector using concentrated sunlight. C. Gibart (Société Européenne de Propulsion, Vernon, Eure, France). *Solar Cells*, vol. 4, Aug. 1981, p. 71-89. 6 refs. Commission of European Communities Contract No. 459-78-1-ESF.

A hybrid prototype photovoltaic-thermal collector using concentrated sunlight was studied theoretically, realized and tested. Reasons are given for choosing this concept. The prototype design is then described and explanations are given for the different technological solutions that are adopted. The test set-up, instrumentation and measurements are described further. The experimental peak electrical and thermal efficiencies are then presented as functions of temperature and concentration ratio and are compared with the efficiencies of specific collectors. Technical feasibility is demonstrated, but economic viability cannot be established at present. Trends for future developments are then indicated. (Author)

A81-49248 Performance of a photovoltaic concentration module consisting of silicon solar cells with a facet cylindrical mirror COSS. R. Bomal and P. Ragot (Commissariat à l'Energie Atomique, Département des Etudes Mécaniques et Thermiques, Gif-sur-Yvette, Essonne, France). *Solar Cells*, vol. 4, Aug. 1981, p. 91-100.

A81-49300 On the surface recombination current of metal-insulator semiconductor inversion layer solar cells. O. M. Nielsen (Danmarks Tekniske Hojskole, Lyngby, Denmark). *Journal of Applied Physics*, vol. 52, Sept. 1981, p. 5870-5872. 14 refs.

The current-voltage characteristics of Al-SiO2-pSi MIS inversion layer solar cells are investigated under dark and illuminated conditions. The cells were fabricated on 111 line-type and 100 line-type pSi wafers with resistivities of 10-15 and 8-10 ohm cm, respectively, with a structure in which the area between the contact holes is treated as an ideal abrupt n(+)-p diode. A crossover point is observed between the dark and the illuminated curves for all 111 line-type cells, however not for the 100 line-type cells. The 111 line-type cells are also found to exhibit lower open-circuit voltages, with the open-circuit voltage differences greater than would be expected on the basis of the dark characteristics. Results are explained in terms of the dependence of the illuminated recombination current on the interface state density, which should therefore be made as small as possible to reduce the surface recombination current and increase open-circuit voltage. A.L.W.

A81-49456 Solar energy technology handbook. Part A - Engineering fundamentals. Edited by W. C. Dickinson (California, University, Livermore, CA) and P. N. Cheremisinoff. New York, Marcel Dekker, Inc. (Energy, Power, and Environment. Volume 6), 1980. 894 p. $85.

Aspects regarding the solar resource are considered, taking into account solar energy and the biosphere, extraterrestrial electromagnetic solar radiation, solar geometry and time, the terrestrial solar spectrum, terrestrial solar radiation availability, a new U.S. network for solar radiation measurements, the instrumentation for solar radiation measurements, and infrared radiation measurements. A description of solar thermal collectors is provided, giving attention to flat-plate and nonconcentrating collectors, concentrating collectors, nonconvective salt-gradient solar ponds, shallow solar ponds, fundamental materials considerations for solar collectors, outdoor testing of solar materials and solar collectors, and standard procedures for collector performance testing. Topics in the area of photovoltaics are related to the principles of photovoltaic conversion, solar cell fabrication, and photovoltaic materials. Attention is also given to bioconversion, wind energy, and solar energy storage systems. G.R.

A81-49457 Solar energy technology handbook. Part B - Applications, systems design, and economics. Edited by W. C. Dickinson (California, University, Livermore, CA) and P. N. Cheremisinoff. New York, Marcel Dekker, Inc. (Energy, Power, and Environment. Volume 6), 1980. 817 p. $85.

The application of solar technology are examined, taking into account domestic water heating, swimming pool heating, building space heating, solar cooling, passive solar design, total energy systems design, the distillation of sea water, irrigation pumping, food dehydration, industrial process heat, data acquisition systems, solar simulation computer programs, and calculation procedures for determining the thermal performance of active solar space heating and domestic hot water systems. Approaches considered for electric power generation are related to thermal conversion, photovoltaics, ocean thermal energy conversion, and wind, waves, and tides. Attention is also given to a simplified method for sizing active solar space heating, an economic methodology for solar hot water and space heating systems, an economic methodology for solar industrial process heat systems, and barriers and incentives in the commercialization of solar energy. Aspects concerning environmental, health, and safety issues are also explored. G.R.

A81-49466 National Passive Solar Conference, 4th, Kansas City, MO, October 3-5, 1979, Proceedings. Volume 4. Edited by G. Franta (Solar Energy Research Institute, Golden, CO). Conference sponsored by the U.S. Department of Energy and International Solar Energy Society. Newark, DE, International Solar Energy Society, 1981. 792 p. $65.

Papers concern recent experience in the research, development and application of passive solar technology. Specific topics include the legislative barriers and incentives to passive solar systems, coupled thermal and lighting simulations for evaluating daylighting design effectiveness, passive solar applications in inner city housing, radiative cooling in a desert climate, salinity gradient solar ponds, the retrofit of a masonry home for passive space heating, the performances of active and passive solar domestic hot water systems, builder experience with passive solar home construction, the use of solar energy installations on farm buildings, and a method of determining the thermal performance of passive storage walls. A.L.W.

A81-49519 * Contact resistivities of sputtered TiN and Ti-TiN metallizations on solar-cell-type-silicon. M. Maenpaa (Califor-

nia Institute of Technology, Pasadena, CA; Technical Research Centre of Finland, Esbo, Finland), M.-A. Nicolet, I. Suni (California Institute of Technology, Pasadena, CA), and E. G. Colgan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Solar Energy*, vol. 27, no. 4, 1981, p. 283-287. 25 refs. Research supported by the U.S. Department of Energy.

The resistivities of TiN and Ti-TiN contacts on a shallow junction solar-cell-type silicon substrate have been determined by the method of the transmission line model. The contacts investigated are shown to be suitable for standard solar cells from an electrical point of view. Contact resistivity values of the order of 0.0001 ohm/sq cm as obtained for the n(+)Si-TiSi2-TiN contact system may be acceptable for concentrations up to 100 times, but lower values are necessary beyond this point. V.L.

A81-49521 **An analysis of convective losses from cavity solar central receivers.** A. M. Clausing (Illinois, University, Urbana, IL). *Solar Energy*, vol. 27, no. 4, 1981, p. 295-300. 8 refs.

A simple analytical model has been developed in order to provide a framework for designing experimental programs for convective loss determinations, for analyzing available experimental data from solar receiver test programs, and for estimating the convective loss at a relatively small cost. Analytical results and experimental evidence indicate that the convective loss from cavity receivers is appreciable, while the effects of wind on the convective loss under normal operating conditions are minimal. The oroposed analytical model provides a means of determining the relative importance of the internal resistances and predicting the bulk air temperature within the convective zone inside the cavity. V.L.

A81-49716 # **Block diagram of the thermoregulator controlling a cylindrical solar collector and the analysis of the thermal process for the optimization of heat production (Schema functionala a regulatorului care comanda procesul termic al unui concentrator solar cilindric si studiul regimului termic in vederea optimizarii conditiilor de extragere a caldurii).** L. David (Timisoara, Institutul Politehnic, Timisoara, Rumania). *Studii si Cercetari de Fizica*, vol. 33, no. 9, 1981, p. 907-916. 5 refs. In Rumanian.

N81-28482# Applied Research Association, Inc., Albuquerque, N. Mex.
FULL-SCALE LOAD TESTS OF EXPERIMENTAL SOLAR-COLLECTOR FOUNDATIONS
Douglas H. Merkle Mar. 1981 36 p Presented at the ASCE Spring Conf., Las Cruces, N. Mex., 27 Mar. 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-7076; CONF-810341-1) Avail: NTIS HC A03/MF A01

Four drilled, reinforced concrete piers, typical of foundations utilized for single axis tracking solar collector systems, were tested to failure under both eccentric lateral and vertical loads. Previously developed equations for lateral and vertical load capacity yielded reasonable predictions, but the tests disclosed the need to improve the foundation anchor bolt assembly, and possibly also the method of mounting the collectors to the foundations. Nevertheless, the lateral and vertical failure loads and moments of all four piers well exceeded specified design values. DOE

N81-28515*# Days Inn of America, Inc., Atlanta, Ga.
SOLAR DOMESTIC HOT WATER SYSTEM MANUAL FOR DAY'S INN, GARLAND, TEXAS Final Report
May 1981 36 p refs Sponsored in part by NASA
(Grant EG-77-G-01-1632)
(NASA-CR-161802) Avail: NTIS HC A03/MF A01 CSCL 10A

The Solar Domestic Hot Water System installed at Day's Inn, I-30 and 6222 Beltline, Garland, Texas, is described. The system is a solar collector array used to provide from 39.9 percent in December, to 84.7 percent in August, of the domestic hot water usage of the Day's Inn in Garland, Texas. The system is an automatic draindown design employing an atmospheric vented storage tank for storing the hot water collected by the 998 sq. ft. collector array. S.F.

N81-28517*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN DESCRIPTION OF THE SCHUCHULI VILLAGE PHOTOVOLTAIC POWER SYSTEM Final Report
Anthony F. Ratajczak, Richard W. Vasicek, and Richard DeLombard May 1981 100 p
(Contract DE-AI01-79ET-20485)
(NASA-TM-82650; DOE/NASA/20485-10) Avail: NTIS HC A05/MF A01 CSCL 10B

A stand alone photovoltaic (PV) power system for the village of Schuchuli (Gunsight), Arizona, on the Papago Indian Reservation is a limited energy, all 120 V (d.c.) system to which loads cannot be arbitrarily added and consists of a 3.5 kW (peak) PV array, 2380 ampere-hours of battery storage, an electrical equipment building, a 120 V (d.c.) electrical distribution network, and equipment and automatic controls to provide control power for pumping water into an existing water system; operating 15 refrigerators, a clothes washing machine, a sewing machine, and lights for each of the homes and communal buildings. A solar hot water heater supplies hot water for the washing machine and communal laundry. Automatic control systems provide voltage control by limiting the number of PV strings supplying power during system operation and battery charging, and load management for operating high priority at the expense of low priority loads as the main battery becomes depleted. A.R.H.

N81-28521*# Belz Investment Co., Memphis, Tenn.
SOLAR HEATING SYSTEM INSTALLED AT BELZ INVESTMENT COMPANY, MEMPHIS, TENNESSEE Final Report
Jun. 1981 100 p refs Sponsored in part by NASA
(Contract EM-78-F-01-5210)
(NASA-CR-161803) Avail: NTIS HC A05/MF A01 CSCL 10A

A hot air solar system which utilizes flat plate air collectors is discussed. Collector areas for each of four buildings cover 780 sq ft, with storage capacity of 390 cu ft per building. The air system has a special air handling unit to move air through the collectors and into and out of the rock storage, with connection to the air duct distribution system. The heat of the motor is added to the heat delivered to the system. The solar system also includes four motorized special low leakage dampers and two gravity fabric dampers. The system is automatically controlled by a solid state controller with three thermistors: one located in the collectors, one in the rock box to plenum, one in the return air duct from the heated space. A three stage heating thermostat, located in the conditioned space, controls the operation. E.A.K.

N81-28524*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR THERMAL POWER SYSTEMS PARABOLIC DISH PROJECT Annual Technical Report
V. C. Truscello 15 May 1981 94 p refs Prepared in cooperation with JPL, California Inst. of Technology, Pasadena
(Contracts NAS7-100; DE-AT04-81AL-16228)
(NASA-TM-82371; JPL-PUB-81-39; DOE/JPL-1060-45) Avail: NTIS HC A05/MF A01 CSCL 10A

The status of the Solar Thermal Power Systems Project for FY 1980 is summarized. Included is: a discussion of the project's goals, program structure, and progress in parabolic dish technology. Analyses and test results of concentrators, receivers, and power converters are discussed. Progress toward the objectives of technology feasibility, technology readiness, system feasibility, and system readiness are covered. E.A.K.

N81-28525# Committee on Science and Technology (U. S. House).
OVERSIGHT: WESTERN SOLAR ENERGY ACTIVITIES
Washington GPO 1980 130 p refs Hearing before the Subcomm. on Energy Develop. and Applications of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 123, 3 Jan. 1980
(GPO-63-657) Avail: Subcommittee on Energy Development and Applications

Development and commercialization of solar energy technology is discussed with regard to the case of California, which leads the other States in its encouragement of solar incentives. The operation of the Western Sun Solar Center, one of four regional solar centers of DOE with responsibility for commercialization, is assessed. S.F.

N81-28527# Committee on Science and Technology (U. S. House).
OVERSIGHT: SOLAR PHOTOVOLTAIC PROGRAM
Washington GPO 1980 164 p Hearing before the Subcomm. on Energy Develop. and Applications of the Comm. on Sci. and

Technol., 96th Congr., 2nd Sess., no. 135, 29 Feb. 1980 (GPO-84-883) Avail: Subcommittee on Energy Development and Applications

Public Law 95-590, the Solar Photovoltaic Energy Systems Research Development and Demonstration Act of 1978, is reviewed, along with the Department of Energy's implementation of the 10 year photovoltaic program. Controversy settles on DOE's emphasis on research and development to the detriment of marketing development and demonstration. S.F.

N81-28531# Sandia Labs., Albuquerque, N. Mex.
OPERATING EXPERIENCE AT THE CENTRAL RECEIVER TEST FACILITY (CRTF)
John T. Holmes, W. Ken Bell, David L. King, Larryl K. Matthews, and Larry O. Seamons 1981 10 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2504C; CONF-810509-13) Avail: NTIS HC A02/MF A01

The CRTF, constructed to develop solar central receiver components, began operating in October, 1978. To date, three solar receivers that used either air, water/steam, or a molten nitrate salt as their working fluid were successfully characterized. Also, seven heliostat concepts were evaluated. These included two competing designs for the 10 MWe solar pilot plant now under construction near Barstow, California, a privately sponsored design, and four advanced designs. Almost three years of operation of the CRTF provided data and experience on the performance and maintenance requirements for typical components of a solar central receiver system. DOE

N81-28533# Department of Energy, Washington, D. C. Energy Information Administration.
ENERGY DATA REPORT: SOLAR COLLECTOR MANUFACTURING ACTIVITY, JULY - DECEMBER 1980
Mar. 1981 50 p
(DOE/EIA-0174/80-2) Avail: NTIS HC A03/MF A01

Statistics on solar collector manufacturing activity for both solar thermal collectors and photovoltaic modules through 1980 are presented. Summary data are given for the number of manufacturers and collector area produced each year from 1974 through 1980; data for collector type are included, i.e., low temperature or medium temperature and special collectors. Producer shipments are tabulated according to location of company headquarters, producer size, and collector types. Import and export activity is tabulated; and tables are given showing the application according of end use, market sector, and market sectors and company headquarers location. The number of companies engaged in activities related to solar collector manufacturing for 1978 through 1980 are listed; and the number of manufacturers and market sector are tabulated for photovoltaic modules manufacturing activities. DOE

N81-28534# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
INDUSTRIAL AND AGRICULTURAL PROCESS HEAT INFORMATION USER STUDY
W. W. Belew, B. L. Wood, T. L. Marle, and C. L. Reinhardt Mar. 1981 246 p
(Contract EG-77-C-01-4042)
(SERI/TR-751-751) Avail: NTIS HC A11/MF A01

Information on solar industrial and agricultural process heat (IAPH) are described. The results of a study on many different solar technologies, identify types of information each group needed and the best ways to get information to each group. Results from 10 IAPH groups of respondents are analyzed in this report: IPH Researchers; APH Researchers; Representatives of Manufacturers of Concentrating and Nonconcentrating Collectors; Plant, Industrial, and Agricultural Engineers, Educators, Representatives of State Agricultural Offices, and County Extension Agents. DOE

N81-28536# Sandia Labs., Albuquerque, N. Mex. Exploratory Systems Div.
DESIGN, COST, AND PERFORMANCE COMPARISONS OF SEVERAL SOLAR THERMAL SYSTEMS FOR PROCESS HEAT. VOLUME 3: RECEIVERS
J. B. Woodard, Jr. Mar. 1981 114 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-8281-Vol-3) Copyright. Avail: NTIS HC A06/MF A01

The receiver subsystem converts reflected solar radiation into thermal power by heating a working fluid. The cost and performance were estimated for the receiver subsystem for parabolic troughs, parabolic dishes, and central receivers over a wide range of temperatures and power levels for thermal power applications. The fundamental design philosophy employed, the constraints identified, the tradeoffs performed and the cost and performance results obtained for each receiver in the study matrix are described. DOE

N81-28537# Sandia Labs., Albuquerque, N. Mex. Energy System Studies Div.
DESIGN, COST AND PERFORMANCE COMPARISONS OF SEVERAL SOLAR THERMAL SYSTEMS FOR PROCESS HEAT. VOLUME 4: ENERGY CENTRALIZATION
J. J. Iannucci and L. D. Hostetler Mar. 1981 94 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-8282-Vol-4) Avail: NTIS HC A05/MF A01

A large matrix of self-consistent piping systems for dishes, troughs, and central receivers are designed, costed, and analyzed for performance. The solar installations collect thermal energy at temperatures ranging from 2000 to 20000 F, at sizes of 3, 30, 300, and 1500 megawatts thermal. First order design differences and similaies are highlighted, with emphasis on the comparison of dish and trough piping. Dishes are found to inefficient piping networks due to the large length of piping required. DOE

N81-28538# Houston Univ., Tex. Energy Lab.
USER MANUAL FOR THE UNIVERSITY OF HOUSTON SOLAR CENTRAL RECEIVER, CELLWISE PERFORMANCE MODEL: NS, VOLUME 1
F. W. Lipps and L. L. Vant-Hull Dec. 1980 198 p refs 2 Vol.
(Contract DE-AC03-79SF-10763)
(DOE/SF-10763/T9-Vol-1; SAN-0763-4-Vol-1) Avail: NTIS HC A09/MF A01

The central receiver cellwise performance model which simulates the optical performance of a solar central receiver system is described. The system contains a collector field with a large number of identical, individually guided, heliostats which reflect sunlight to a tower top receiver. For simulation, the collector field is divided into cells, and a representative heliostat at each cell center is used to estimate the effect of the heliostats in the cell. Typical applications include: a receiver flux density run, an annual performance summary run, a start-up performance study, and a performance study during a cloud passage. DOE

N81-28539# Houston Univ., Tex. Energy Lab.
USER MANUAL FOR THE UNIVERSITY OF HOUSTON SOLAR CENTRAL RECEIVER, CELLWISE PERFORMANCE MODEL: NS, VOLUME 2
F. W. Lipps and L. L. Vant-Hull Dec. 1980 123 p 2 Vol.
(Contract DE-AC03-79SF-10763)
(DOE/SF-10763/T9-Vol-2; SAN-0763-4-Vol-2) Avail: NTIS HC A06/MF A01

A complete listing is given of the inputs and outputs of four test runs designed to illustrate the most important features of the NS cellwise performance code. DOE

N81-28542# Duke Univ., Durham, N. C.
ASSESSMENT OF ACTIVE SOLAR SYSTEMS IN THE RESIDENTIAL SECTOR OF NORTH CAROLINA, 1974 - 1995 Report, 1 Nov. 1978 - 31 Dec. 1979
Diane Brown and Karen St.John 1 Feb. 1981 55 p refs Sponsored by Dept. of Commerce
(NCEI-0030) Avail: NTIS HC A04/MF A01

An evaluation is presented of the contribution active solar systems can make in North Carolina's residential sector over the next 15 years. The report is divided into 5 parts: introduction; current solar industry status; projected use of active solar systems to 1995; maximum potential for active solar systems to 1995; recommendations for state solar incentives. Information in the appendices includes: conversion methodology; square feet of collector to Btu; economic analysis of solar systems based on life costs; methodology for percentage breakdowns on projected solar system sales; North Carolina solar manufacturers/distributors and national manufacturers; solar legislation; economic analysis of solar systems; and data sources. DOE

N81-28545# Alabama Univ. in Huntsville. Dept. of Mechanical Engineering.
NUMERICAL AND EXPERIMENTAL STUDIES OF LIQUID STORAGE TANK THERMAL STRATIFICATION FOR A SOLAR ENERGY SYSTEM

S. T. Wu Nov. 1980 81 p refs
(Contracts DE-AS02-77CS-34479; EG-77-S-02-4479)
(DOE/CS-34479/3) Avail: NTIS HC A05/MF A01

The results of theoretical and experimental studies of thermal stratification in liquid energy storage tanks for the performance of solar energy systems are presented. The investigation was divided into three areas: (1) justification of the importance of thermal stratification inside the energy storage tanks; (2) development of simple mathematical model which is compatible with existing solar energy system simulation code; and (3) validation of mathematical models by experimental data obtained from realistic solar energy system operations. DOE

N81-28546# Sandia Labs., Livermore, Calif. Energy Systems Studies Div.
IMPACT OF NATURAL CLEANING ON THE SELECTION OF A WASHING SYSTEM FOR SOLAR COLLECTORS
Alan Kerstein Apr. 1981 25 p refs
(Contract DE-AC04-76DP-00189)
(SAND-81-8636) Avail: NTIS HC A02/MF A01

The desired optical properties (reflectivity, transmissivity, etc.) of solar energy collector surfaces such as mirrors and photovoltaic surfaces are degraded over time by soiling. Cost benefit evaluation of alternative methods for washing the surface or retarding the optical degradation must take into account natural cleaning processes such as precipitation and frost, which impact the scheduling as well as the benefits of washing. A probabilistic method developed to address this question is used to compare truck-mounted versus mirror-mounted washing systems for central receiver plants. The comparison of these systems is shown to be sensitive to the seasonally-varying frequency and effectiveness of natural cleaning processes. The implications of this analysis for such diverse issues as cost/benefit evaluation of soil-retardent mirror coatings and formulation of plant site selection criteria are noted. DOE

N81-28547# Sandia Labs., Livermore, Calif.
DESIGN, COST, AND PERFORMANCE COMPARISONS OF SEVERAL SOLAR-THERMAL SYSTEMS FOR PROCESS HEAT. VOLUME 2: CONCENTRATORS
E. D. Eason Mar. 1981 68 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-8280-Vol-2) Avail: NTIS HC A04/MF A01

The major mechanical design and cost differences between concentrator subsystems are identified. Parabolic dishes and troughs are designed to the same specifications as heliostats, using the same glass mirror/steel structure design concept and their costs are estimated on a consistent, comparable basis, using the heliostat cost data base. Inherent cost differences arise from differences in geometry, the cost of providing curvature and wind loadings. The estimated cost increases, relative to heliostats, are 15 percent to 50 percent for dishes and 0 percent to 30 percent for troughs, considering the combined effect of several analysis uncertainties. DOE

N81-28561# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
DESIGN CONSIDERATIONS FOR SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS: NONTRACKING AND LINE FOCUS COLLECTOR TECHNOLOGIES
Charles F. Kutscher, ed. Mar. 1981 64 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-632-783) Avail: NTIS HC A04/MF A01

Items are listed that should be considered in each aspect of the design of a solar industrial process heat system. The collector technologies covered are flat plate, evacuated tube, and line focus. Qualitative design considerations are stressed rather than specific design recommendations. DOE

N81-28562# Brookhaven National Lab., Upton, N. Y.
STUDY OF GAP STATES IN A-Si:H ALLOYS BY MEASUREMENTS OF PHOTOCONDUCTIVITY AND SPECTRAL RESPONSE OF MIS SOLAR CELLS
P. E. Vanier, A. E. Delahoy, and R. W. Griffith 1981 7 p refs Presented at the Conf. on Tetrahedrally Bonded Amorphous Semi-Conductors, Carefree, Ariz., 12 Mar. 1981
(Contract DE-AC02-76CH-00016)
(BNL-29160; CONF-810331-1) Avail: NTIS HC A02/MF A01

Modifications in n(E) were studied by the effects of selected impurities on the conversion efficiency and spectral response of MIS and p-i-n solar cells. A picture of the density of gap states n(E) in glow discharge a-Si:H is constructed using four different kinds of transport measurement on a large number of samples. The minimum in n(E) lies 0.4 eV below E sub c, rather than in the middle of the gap. A distribution of fast recombination centers lies at mid gap, and two sets of hole traps lie between mid gap and the valence band.

N81-28563# Mueller Associates, Inc., Baltimore, Md.
ECONOMIC ANALYSIS OF COMMERCIAL SOLAR COMBINED SPACE-HEATING AND HOT-WATER SYSTEMS
23 Sep. 1980 66 p Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(ANL-K-80-53; MAI-204) Avail: NTIS HC A04/MF A01

Typical commercial solar energy systems and typical cost and performance levels are outlined. The economic performance of solar energy systems are described through the use of cash flow diagrams. The diagrams indicate the cumulative cash situation of a solar investment over the life of the investment. The economic performance of solar energy systems is outlined through the calculation of equivalent return on investment (ROI). Appendices are included to enable calculating the ROI for any particular solar energy system investment. DOE

N81-28564# Mueller Associates, Inc., Baltimore, Md.
ECONOMIC ANALYSIS OF NON-TAXED COMMERCIAL SOLAR HOT WATER SYSTEMS AND COMBINED HEATING AND HOT WATER SYSTEMS
23 Sep. 1980 85 p
(Contract MAI-205)
(ANL-K-80-44) Avail: NTIS HC A05/MF A01

An economic analysis of nontaxed commercial solar systems is presented. A realistic evaluation of current cost effectiveness of nontaxed commercial solar energy systems is provided. Economic considerations involved in the decisions to invest in a solar system are described. Easy to use tools to make rational decisions regarding economic viability of nontaxed commercial solar energy systems in a particular application are outlined. E.A.K.

N81-28581# Midwest Research Inst., Golden, Colo. Solar Thermal Program Branch.
SOLAR THERMAL COST GOALS
R. B. Edelstein Jan. 1981 9 p refs Presented at the 3rd Ann. Systems Simulation, Economic Analysis/Solar Heating and Cooling Operational Results Conf., Reno, Nev., 29 Apr. - May 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-633-1063; CONF-810405-13) Avail: NTIS HC A02/MF A01

Setting of goals for a research, development and demonstration program is critical in measuring its progress and ensuring its success. The development of cost goals for the DOE Solar Thermal Program by the Solar Thermal Cost Goals Committee (STCGC), led by the Solar Energy Research Institute, is described. The objective of the STCGC is to determine a consistent set of time-related cost and performance goals for concentrating collector systems based on market value and intermediate goals based on attainable cost levels. Accomplishments thus far include: definition of cost goals and their function in program planning, delineation of competing energy system costs, development of a breakeven costing methodology for assessing market value, determination of attainable costs for solar thermal systems, setting financial and economic parameters, and calculation of market value as a function of each competing fuel type, application, and region. DOE

N81-28582# Midwest Research Inst., Golden, Colo.
PREFERENCES AND CONCERNS OF POTENTIAL USERS IN THE SELECTION OF SOLAR THERMAL SYSTEMS FOR INDUSTRIAL AND SMALL UTILITY APPLICATIONS
James B. Gresham (Science Applications, Inc., Golden Colo.) and Thomas A. Kriz Mar. 1981 12 p refs Presented at the 8th Energy Technol. Conf. and Exposition, Washington, D.C., 9-11 Mar. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-731-1128; CONF-810315-9) Avail: NTIS HC A02/MF A01

To achieve widespread application in the industrial and utility sectors, solar systems must be economically competitive. Economic viability is, in turn, determined by a number of supporting criteria, ranging from system reliability to dispatch characteristics to how the system supports the main product line. In addition, solar systems possess some inherent attributes that may render

some of the traditional supporting criteria inappropriate or require their redefinition. Those criteria and their relation to the solar investments are discussed in three steps. First, the main concerns and preferences of the potential users, as identified in recent SERI studies, are identified. Second, the equitability of the resulting decision criteria for solar investments are examined. Finally, the implications of these criteria for solar energy's penetration into these markets are discussed. DOE

N81-28564# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THREE-YEAR PERFORMANCE STUDY OF THE MEAD, NEBRASKA, 25-kWp PHOTOVOLTAIC POWER SYSTEM
Henry J. Bullwinkel and Raymond F. Hopkinson 1981 6 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philidelphia, 27-30 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/122) Avail: NTIS HC A02/MF A01

The performance of a 25 kWp photovoltaic (PV) solar energy system was studied. Electrical energy produced by the PV system provided 100% of the power needed throughout the growing season to meet the irrigation requirements for an 80 acre cornfield, as well as significant portions of power required for PV related crop drying and fertilizer manufacturing experiments. Field data indicate that the PV system performs up to expectations, if allowance is made for component degradation and seasonal soil/snow accumulation on the array. DOE

N81-28565# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RELIABILITY OF TERRESTRIAL PHOTOVOLTAIC MODULES AT VARIOUS DOE/MIT LINCOLN LABORATORY TEST SITES
S. E. Forman and M. P. Themelis 30 Mar. 1981 5 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/128; CONF-810526-1) Avail: NTIS HC A02/MF A01

During the past four years, acting under the auspices of the US Department of Energy, Massachusetts Insitute of Technology Lincoln Laboratory built and operated in the United States photovoltaic power-generating systems ranging in size from less than 1 kWp to 100 kWp. Slightly more than 11,000 modules from several maufacturers were utilized at these sites with a cumulative number of electrici failures of approximately 2%. Discussion is presented of module performance at two of these sites; a 25-kWp array field at Mead, Nebraska, and a 100-kWp array field at Natural Bridges National Monument, Utah. Data and photographs of module failures, failure modes, physical and electrical degradation, and array diagnostics are presented for each of the five different types of modules utilized at these sites. DOE

N81-28566# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLAR PHOTOVOLTAIC RESIDENCE IN CARLISLE, MASSACHUSETTS
S. J. Strong (Solar Design Associated, Lincoln, Mass.) and B. E. Nichols 1981 4 p Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 27-30 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/129; CONF-810509-9) Avail: NTIS HC A02/MF A01

The first solar photovoltaic house designed and constructed under the US Department of Energy's Solar Photovoltaic Residential Project is studied. The house, which is powered by a 7-k Wp photovoltaic (PV) system, will be used to assess the occupants' acceptance of and reactions to residential photovoltaic systems and to familiarize utilities, builders, developers, town building officials and others with issues concerning photovoltaic installations. The house includes energy conservation and passive solar features. It utilizes a roof mounted, flat plate PV array which operates in a two way energy exchange mode with the electric utility. The energy conservation and passive solar features of this house are described and a detailed description of the utility interactive photovoltaic system is presented, along with initial performance data. DOE

N81-28567# Midwest Research Inst., Golden, Colo.
APPLIED RESEARCH IN THE SOLAR THERMAL ENERGY SYSTEMS PROGRAM
C. T. Brown (Georgia Inst. of Technology, Atlanta) and J. M. Lefferdo Mar. 1981 7 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26-30 May 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-633-1148; CONF-810509-10) Avail: NTIS HC A02/MF A01

Within the Solar Thermal Research and Advanced Development (RAD) program a coordinated effort in materials research, fuels and chemical research and applied research is being carried out to meet the systems needs. Each of these three program elements is described with particular attention given to the applied research activity. DOE

N81-28568# Mueller Associates, Inc., Baltimore, Md.
ECONOMIC ANALYSIS OF RESIDENTIAL SOLAR WATER HEATERS
John Carlock and Ronald Overton 23 Sep. 1980 98 p refs
(Contract W-31-109-eng-38)
(ANL-K-80-68; MAI-201) Avail: NTIS HC A05/MF A01

A residential solar water heater, cost and performance information, and monthly costs and savings of the typical system are discussed. Economic evaluations of solar water heaters are presented in increasingly complex levels of detail. Utilizing a typical system, the effective interest rate that the purchaser of a system would receive on money invested is shown for all regions of the country. The importance of numerous variables that can make a significant difference on the economics of the system is described. Methods for calculating the payback period for any nontypical solar water heater are described. This calculated payback period is shown to be related to the effective interest rate that the purchaser of the system would receive for a typical set of economic conditions. A method is presented to calculate the effective interest rate that the solar system can provide. DOE

N81-28569# Arizona State Univ., Tempe. Coll. of Architecture.
HARDWARE PACKAGE AND WORKSHOP DEVELOPMENT FOR HOMEOWNER SOLAR WATER HEATER Final Report
Stanley A. Mumma Sep. 1980 288 p refs
(Contract DE-FG03-78SF-01973; Grant EM 78-G-03-1973)
(DOE/SF-01973/T1) Avail: NTIS HC A13/MF A01

It was the purpose of this project to: (1) develop a standard solar hot water heater package, (2) develop a workshop for the assembly of these components by the homeowner, (3) provide guidance on how the components may be retrofit to existing homes in accordance with local codes and good practices, (4) provide operating and maintenance instructions, and (5) provide this community service at a target cost of $300 to $400 for the complete solar water package including the enrollment and workshop. The solar hot water system's thermal performance and development of a solar company are discussed. Nationwide expansion of the program is proposed. DOE

N81-28570# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
USE OF AN OPEN-CYCLE ABSORPTION SYSTEM FOR HEATING AND COOLING
D. R. Schlepp and R. K. Collier Mar. 1981 7 p refs Presented at the Intern. Solar Energy Soc. Am. Sect. Ann. Conf., Philadelphia, 26-30 May 1981
(Contracts EG-77-C-01-4042; DE-AC02-77CH-00178)
(SERI/TP-631-1159; CONF-810509-11) Avail: NTIS HC A02/MF A01

Solar cooling for commercial applications using open cycle absorption refrigeration systems was investigated. If an open cycle absorption can be operated as a chemical heat pump for winter heating operation, the system offers year round operation that makes the system economically viable for many regions of the US. An analysis of heating operation for the open cycle system using a computer program that simulates heat and mass transfer processes for any environmental condition is also presented. The open cycle absorption refrigeration system can be operated as a chemical heat pump. Simulations for winter heating operation were run for five US cities, with solar SOP's in the range of 0.6 to .16. It is concluded that at these levels, the OCAR system can provide full heating and cooling operation for office buildings in many southern US cities. DOE

N81-28571# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
VALUE OF THERMAL STORAGE IN SOLAR IPH SYSTEMS
S. M. Hock and M. E. Karpuk Dec. 1980 7 p refs Presented at the 3rd Ann. Systems Simulation, Econ. Analysis/Solar Heating and Cooling Operational Results Conf., Reno, Nov., 27 Apr. 1981
(Contracts EG-77-C-01-4042; DE-AC02-77CH-00178)
(SERI/TR-731-905; CONF-810405-14) Avail: NTIS

HC A02/MF A01

The value of thermal storage for three solar industrial process heat systems for capacities of 3 to 4000 hours was determined. The dominant source of storage value is backup fuel savings with additional value derived from increased capital equipment utilization and elimination. A computer simulation was used to model the operation of the solar IPH system and predict the amount of fuel saved by heat delivered from storage. Sensitivity of storage value of process temperature, collector cost, load profile, insolation, and storage efficiency was calculated. Storage values ranged from heat zero t as high as $42/kWH of storage capacity. DOE

N81-28586# Sandia Labs., Albuquerque, N. Mex.
INCENTIVES FOR SOLAR ENERGY IN INDUSTRY
Kenneth D. Bergeron May 1981 33 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0048) Avail: NTIS HC A03/MF A01

Several issues are analyzed on the effects that government subsidies and other incentives have on the use of solar energy in industry, as well as on other capital-intensive alternative energy supplies. Discounted cash flow analysis is used to compare tax deductions for fuel expenses with tax credits for capital investments for energy. The result is a simple expression for tax equity. The effects that market penetration of solar energy has on conventional energy prices are analyzed with a free market model. It is shown that net costs of a subsidy program to the society can be significantly reduced by price. Several government loan guarantee concepts are evaluated as incentives that may not require direct outlays of government funds; their relative effectiveness in achieving loan leverage through project financing, and their cost and practicality, are discussed. DOE

N81-28587# Battelle Pacific Northwest Labs., Richland, Wash.
PHOTOVOLTAICS
J. E. Garnier Apr. 1981 31 p refs Prepared for Washington Univ., Bellingham
(Contract DE-AC06-76RL-01830)
(PNL-SA-9464) Avail: NTIS HC A03/MF A01

Drawings, graphs, and brief notes are presented. They are used to outline the theory of solar cells and the national photovoltaic program. DOE

N81-28588# Sandia Labs., Albuquerque, N. Mex.
IMPLEMENTATION PLAN (MAY 1979): BATTERIES FOR SPECIFIC SOLAR APPLICATIONS
Robert P. Clark Apr. 1981 18 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-0216) Avail: NTIS HC A02/MF A01

The scope and objectives of the batteries for specific solar applications Project (BSSAP) are discussed. The BSSAP consists of five major tasks: (1) Battery Requirements Analysis, (2) Laborator Evaluation; (3) Photovoltaic Advanced Systems Tests; (4) Photovoltaic Applications Experiments; and (5) Battery Research and Development. All five tasks are described, and the schedule and milestones for completing each task are listed. Requirements for annual reporting and reviews are specified, and the ESSAP is linked to the existing Sandia/DOE PV Project. DOE

N81-28591# California Energy Commission, Sacramento.
DIFFUSION OF SOLAR ENERGY TECHNOLOGIES IN THE NEW-CONSTRUCTION MARKET: A SURVEY OF NEW SOLAR-HOME AND CONVENTIONAL-HOME BUYERS
Diana Rains, Deborah Dunipsco, and C. K. Woo Feb. 1981 64 p
(DOE/EIA-10189/T2) Avail: NTIS HC A04/MF A01

Consumer motivations for choosing a solar energy equipped home when the nonsolar or conventional model was available were investigated. The approach was to test the relative importance of demographic, dwelling unit, and heating system characteristics in household decisions to purchase a home equipped with solar energy devices. Two statistical models were developed: one to examine the relationship between the types of home buyers (as an identifiable market segment) and the decision to purchase a solar home; and the other to compare the energy use of solar vs. conventional homes selected in the sample. DOE

N81-28603# National Bureau of Standards, Washington, D.C. Center for Building Technology.
WIND, EARTHQUAKE, SNOW, AND HAIL LOADS ON SOLAR COLLECTORS
Louis Cattaneo, James Robert Harris, Timothy A. Reinhold, Emil Simiu, and Charles W. C. Yancey Jan. 1981 95 p refs Sponsored in part by DOE
(PB81-164550; NBSIR-81-2199) Avail: NTIS HC A06/MF A01 CSCL 10A

Wind-tunnel, full-scale, and field studies of wind and snow loads on flat plate solar collectors are described and results are used to develop information, guidelines, and criteria for the design of flat plate collectors subjected to the action to wind, snow, and earthquake loads. Also given are data on hail loads, based on information and studies available in the literature. GRA

N81-29189# Ames Lab., Iowa. Materials Sciences Program.
PREPARATION OF HIGH-PURITY SILICON USING THERMITE REACTIONS Final Report, 1 Oct. 1979 - 30 Nov. 1980
F. A. Schmidt and D. K. Rehbein 1980 106 p refs Sponsored in part by ARCO Solar, Inc.
(Contract W-7405-eng-82)
(IS-4762) Avail: NTIS HC A06/MF A01

A preparation of silicon by metallothermic reduction of sodium fluorosilicate (Na_2SiF_6) and silicon tetrafluoride (SiF_4) using magnesium and sodium was evaluated. Reduction of Na_2SiF_6 with magnesium gave a product containing 35 to 42 wt % magnesium. The impurities from the Na_2SiF_6 were found to concentrate in the silicon alloy produced. Reduction with sodium yielded finely divided silicon in a salt matrix. The reduction of SiF_4 produced by the thermal dissociation of Na_2SiF_6 was then investigated. With magnesium as reductant, no thermal booster was required but the product was again a silicon magnesium alloy. A small quantity of silicon comparable in purity to that produced from the silane process was also prepared by the sodium reduction of SiF_4. A preliminary cost analysis of producing 225 kg of silicon per day by the metallothermic reduction of SiF_4 with sodium was also prepared. DOE

N81-29255# SRI International Corp., Menlo Park, Calif.
SOLAR PHOTO-CATALYTIC HYDROGEN: SYSTEMS CONSIDERATIONS, ECONOMICS, AND POTENTIAL MARKETS Final Report
Robert V. Steele and Jeffrey G. Witwer May 1981 87 p refs
(Contract DE-AC03-80ER-10190; SRI Proj. CRU-2043)
(DOE/ER-10190/T1) Avail: NTIS HC A05/MF A01

A three part analysis was done consisting of an examination of the physcial principles of solar photocatalytic energy conversion and the status of research in this area, an economic analysis of the potential costs of producing hydrogen from such a system, and an analysis of the markets for hydrogen and the possible penetration of these markets by solar photocatalytic hydrogen. The cost range of flat plate thermal collectors, heliostats, and a photovoltaic system are compared. The cost range of flat plate thermal collectors was used to represent the cost of photocatalytic systems. On the basis o the photovoltaics cost outlook, it is found that photocatalytic systems would not cost less than $180 to $330 per sq m range. On the basis of the heliostat cost outlook, a cost lower than $180 to $330 per m could be projected only for very large production volumes and very large installations. DOE

N81-29270# California Univ., Livermore. Lawrence Livermore Lab.
SOLAR COAL GASIFICATION: PLANT DESIGN AND ECONOMICS
William R. Aiman, Charles B. Thorsness, and David W. Gregg 23 Feb. 1981 12 p refs Presented at the 73rd Ann. Meeting of the Am. Inst. of Chem. Engr., Chicago, Nov. 1980 Revised Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84610-Rev-1; CONF-801104-6) Avail: NTIS HC A02/MF A01

A plant design was layed out in which focused solar energy is used to gasify coal and the resulting synthesis gas is converted into pipeline gas. The overall performance of the plant and its economics were compared to a similar Lurgi plant. The advantage of the solar coal gasification (SCG) method is conservation of coal, 40% more product can be produced from a given amount of coal. The primary detriment of SCG is he 8 h/day operation; which leads to a higher plant investment for a given annual production. This factor is twice as important as the cost of the

heliostat field. Thus, operating costs are lower but capital costs are higher. DOE

N81-29305# Mueller Associates, Inc., Baltimore, Md.
AIR LEAKAGE IN RESIDENTIAL SOLAR HEATING SYSTEMS
Jefferson G. Shingleton, David E. Cassel, and Ronald L. Overton Feb. 1981 200 p refs Sponsored in part by DOE, Washington, D.C. and HUD, Washington, D.C.
(Contract NBS-78-SBCA-3534)
(PB81-176380; NBS-GCR-81-302) Avail: NTIS HC A09/MF A01 CSCL 13A

A series of computer simulations was performed to evaluate the effects of component air leakage on system thermal performance for a typical residential solar heating system, located in Madison, Wisconsin. Auxiliary energy required to supplement solar energy for space heating was determined using the TRNSYS computer program, for a range of air leakage rates at the solar collector and pebble bed storage unit. The effects of heat transfer and mass transfer between the solar equipment room and the heated building were investigated. The effect of reduced air infiltration into the building due to pressurized by the solar air heating system were determined. A simple method of estimating the effect of collector array air leakage on system thermal performance was evaluated, using the f CHART method. GRA

N81-29396# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
DIRECT CONTACT LIQUID-LIQUID HEAT EXCHANGER FOR SOLAR HEATED AND COOLED BUILDINGS Final Report, 1 Jan. 1979 - 30 May 1980
Susumu Karaki and P. Brothers Jun. 1980 161 p refs
(Contracts DE-AS02-76CS-32867; EY-76-S-02-2867)
(DOE/CS-32867/12; C00-2867-8) Avail: NTIS HC A08/MF A01

The technical and economic feasibility of using a direct contract liquid-liquid heat exchanger (DCLLHE) storage unit in a solar heating and cooling system is established. Experimental performance data were obtained from the CSU Solar House I using a DCLLHE for both heating and cooling functions. A simulation model for the system was developed. The model was validated using the experimental data and applied in five different climatic regions of the country for a complete year. The life-cycle cost of the system was estimated for each application. The results are compared to a conventional solar system, using a standard shell-and-tube heat exchanger. It is concluded that while there is a performance advantage with a DCLLHE system over a conventional solar system, the advantage is not sufficiently large to overcome slightly higher capital and operating costs for the DCLLHE system. DOE

N81-29399# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
DIRECT CONTACT LIQUID-LIQUID HEAT EXCHANGER FOR SOLAR-HEATED AND COOLED BUILDINGS Final Report, 1 Jan. 1979 - 30 May 1980
S. Karaki and P. Brothers Jun. 1980 165 p refs
(Contract DE-AS02-76CS-32867)
(DOE/CS-32867/T1) Avail: NTIS HC A08/MF A01

The procedure used was to obtain experimental performance data from a solar system using a DCLLHE for both heating and cooling functions, develop a simulation model for the system, validate the model using the data, apply the model in five different climatic regions of the country for a complete year, and estimate the life-cycle cost of the system for each application. The results are compared to a conventional solar system, using a standard shell-and-tube heat exchanger. DOE

N81-29402# Bechtel National, Inc., San Francisco, Calif.
PRELIMINARY HEAT PIPE TESTING PROGRAM Final Technical Report
Mar. 1981 282 p refs Sponsored in part by Dynatherm Corp. and Foster Wheeler Development Corp.
(Contract DE-AC03-79SF-10756)
(DOE/SF-10756/1) Avail: NTIS HC A13/MF A01

The combined cycle solar power system studies are described. The heat pipe receiver analysis and its results are presented. The test plans and designs of the test stands and test articles are described. The test results and evaluation of these results are presented. Author (DOE)

N81-29403# E-Tech, Inc., Atlanta, Ga.
SOLAR-ASSISTED HEAT PUMP FIELD PERFORMANCE EVALUATION Final Report
28 Nov. 1980 151 p refs
(DOE/SF-10849/T1) Avail: NTIS HC A08/MF A01

An analysis carried out to determine some guidelines to use in laying out six ground coil installations is summarized. The installation of the solar assisted ground coupled heat pumps is described. The instrumentation employed at each of the installations in order to obtain performance data is discussed. DOE

N81-29439# Oak Ridge National Lab., Tenn. Solid State Div.
APPLICATIONS OF LASER ANNEALING AND LASER-INDUCED DIFFUSION TO PHOTOVOLTAIC CONVERSION First Year Report, 1 Mar. 1980 - 28 Feb. 1981
Douglas H. Lowndes, Rosa T. Young, and Richard F. Wood 1981 20 p refs Presented at the High Efficiency Concentrator and 3-5 Compd. Contractors In-Depth Rev. Meeting, Raleigh, N.C., 31 Mar. - 2 Apr. 1981
(Contract W-7405-eng-26)
(CONF-810349-1) Avail: NTIS HC A02/MF A01

It is demonstrated that a variety of techniques involving pulsed laser irradiation of both single crystal and polycrystalline silicon by pulsed lasers can result in the reproducible achievement of high efficiency silicon solar cells. Pulsed laser annealing after an ion implantation step results in melting (for a time of order 100 nsec) and essentially defect free liquid phase epitaxial regrowth with approx. 0.5 microns of the surface. Complete electrical activation of a number of dopant ions, at concentrations exceeding ordinary solubility limits, is demonstrated and crystalline (polycrystalline) silicon solar cell efficiencies of 16.6 percent (12.5 percent) obtained. Unique and beneficial advantages of pulsed laser processing in polycrystalline silicon are discussed. DOE

N81-29469# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
EVALUATION OF CONVENTIONAL ELECTRIC POWER GENERATING INDUSTRY QUALITY ASSURANCE AND RELIABILITY PRACTICES
R. T. Anderson and H. A. Lauffenburger Mar. 1981 110 p refs
(Contract DE-AC02-77CH-00178)
(SERI/TR-742-784) Avail: NTIS HC A06/MF A01

The techniques and practices utilized in an allied industry (electric power generation) that might serve as a baseline for formulating Quality Assurance and Reliability (QA and R) procedures for photovoltaic solar energy systems were studied. The study results provide direct near term input for establishing validation methods as part of the SERI performance criteria and test standards development task. DOE

N81-29526*# SRI International Corp., Menlo Park, Calif.
AN ANALYSIS OF SOLAR PANEL ASSEMBLY AS A PRISON INDUSTRY
Ruth M. Lizak Nov. 1980 84 p refs
(Contract NAS2-10143; SRI Proj. 8134)
(NASA-CR-166158) Avail: NTIS HC A05/MF A01 CSCL 10A

An analysis of the effect of manufacturing solar collectors by California prison inmates is presented. It was concluded that the concept is feasible and would have little adverse effect on the private sector's solar industry. L.F.M.

N81-29533*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PERFORMANCE EVALUATION OF THE SOLAR BUILDING TEST FACILITY
Ronald N. Jensen Aug. 1981 27 p refs
(NASA-TM-83127; L-14595) Avail: NTIS HC A02/MF A01 CSCL 10A

The general performance of the NASA Solar Building Test Facility (SBTF) and its subsystems and components over a four year operational period is discussed, and data are provided for

a typical one year period. The facility consists of a 4645 sq office building modified to accept solar heated water for operation of an absorption air conditioner and a baseboard heating system. An adjoining 1176 sq solar flat plate collector field with a 114 cu tank provides the solar heated water. The solar system provided 57 percent of the energy required for heating and cooling on an annual basis. The average efficiency of the solar collectors was 26 percent over a one year period. M.G.

N81-29537# Solaron Corp., Englewood, Colo.
DEVELOPMENT OF A HIGH PERFORMANCE AIR HEATER THROUGH USE OF AN EVACUATED TUBE COVER DESIGN Final Report
D. E. Jones, L. E. Shaw, and G. O. G. Loef 1981 137 p refs
(Contracts DE-AC04-78CS-34193; EM-78-C-04-4193)
(DOE/CS-34193/T1) Avail: NTIS HC A07/MF A01

Work consisted of a literature survey, fabrication of the tubes, solar transmittance tests, thermal conductance tests, collector design, prototype construction; prototype testing, and finally performance and cost evaluation. Two types of evacuated tubes were manufactured, clear tubes and tubes with an infrared reflective coating. The tubes were arranged parallel in a close packed flat array to form a transparent cover for the collector. The array transmittance of clear tubes is similar to that of two flat sheets of low absorptance glass. The coated tube array had substantially reduced transmittance. Thermal conductance tests indicated that the tube arrays perform similar to two flat sheets of glass with an evacuated space. DOE

N81-29538# Kimpel (Timothy H.), Roseville, Ohio.
USING THE SUN AND WASTE WOOD TO HEAT A CENTRAL OHIO HOME Final Technical Report, 1 Sep. 1980 - 1 Mar. 1981
Timothy H. Kimpel 1981 39 p
(Contract DE-FG02-79R5-10146)
(DOE/R5-10146/2) Avail: NTIS HC A03/MF A01

A house in Ohio built on a south facing slope with two levels above ground on the north, east, and west sides and three levels exposed to the southern winter Sun is described. The following topics are discussed: a general history of the project; operation of the system; backup heat source (wood); collection of data; and the procedure for determining actual heat loss. The calculation of the solar contribution percentage and the amount of mass to be included in the greenhouse and problems with an indirect gain wall are also discussed. The location of the wood stove in the system is noted and east wall temperature data are given. Soil temperature, air infiltration, thermal comfort, and energy usage are enumerated. DOE

N81-29541# Wisconsin Univ. - Madison.
APPLICATION OF SOLAR HOT WATER AND GEOTHERMAL PRINCIPLES TO CLOSED-CYCLE AQUACULTURE Final Report
Richard A. Yanzito Apr. 1981 51 p
(Contract DE-FG02-80R5-10253)
(DOE/R5-10253/1) Avail: NTIS HC A04/MF A01

The design of an underground silo where warm water food fish could be raised to market size under controlled conditions. The building and solar concept analysis for the closed cycle aquaculture system are described. Energy conservation features of the design include Earth barming and insulation of the production silo and enclosure, a waste water reclaim system and a solar heating system. Much of the water surface area is covered with removable plants to minimize evaporative heat losses. An energy conservation analysis is also reported and the F-Chart computer program is described. The system chosen utilizes single glazed flat plate collectors in a closed loop antifreeze system. Makeup water is introduced during an 8 hour period each day. Solar energy is transferred from the antifreeze solution to the makeup water after it leaves the waste water heat exchanger. DOE

N81-29544# JBF Scientific Corp., Wilmington, Mass.
NORTHEAST REGIONAL ASSESSMENT STUDY FOR SOLAR ELECTRIC OPTIONS IN THE PERIOD 1980 - 2000
Apr. 1981 330 p refs
(Contract DE-AC08-77ET-20375)
(DOE/ET-20375/T1) Avail: NTIS HC A15/MF A01

Opportunities for demonstration and large scale deployment of solar electric facilities are identified and assessed. Technical, economic, and institutional factors that can contribute to an accelerated use of solar energy for electric power generation are defined. The following topics are covered: a description of the Northeast Region and its solar resources, central station applications, a dispersed user analysis, user viewpoints and institutional factors, and market potential for dispersed solar electric systems. DOE

N81-29640# Acurex Corp., Mountain View, Calif. Alternate Energy Div.
SOLAR PRODUCTION OF INDUSTRIAL PROCESS STEAM. PHASE 2: FABRICATION AND INSTALLATION Final Report, 1 Jul. 1978 - 31 Jan. 1980
S. B. Youngblood Feb. 1981 173 p refs
(Contract DE-AC03-77CS-31713)
(SAN-1713-3) Avail: NTIS HC A08/MF A01

A solar facility that provides 445 K (345 F) process steam is described. The facility consists of 1070 sq m (11,520 sq ft) of parabolic trough concentrating collectors, an 18,921 l (5000 gal) flash boiler, and a 20 hp circulating pump. The construction, startup/checkout, costs, and performance of this solar facility are summarized. DOE

N81-29652# Los Alamos Scientific Lab., N. Mex. Economics Group.
REGIONAL VARIATION IN SOLAR ENERGY ECONOMIC PERFORMANCE
Dean Brunton, Christina Kirschner, Shaul Ben-David, and Fred Roach 1981 5 p refs Presented at the Ann. of the Intern. Solar Energy Soc., Philadelphia, 26-29 May 1981 Prepared in cooperation with New Mexico Univ., Albuquerque
(Contract W-7405-eng-36)
(LA-UR-81-1203; CONF-810509-35) Avail: NTIS HC A02/MF A01

A solar economic performance code (EASE-III) was used to indicate the extent of production function variations as applied to a Trombe wall solar design incorporated in a new home. The economic performance of the solar heated residence was compared to the alternative non solar home heated by the characteristic conventional fuel of each region. These economic results are used to discuss the impact of subsidy programs. DOE

N81-29655# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
SOLAR-ENERGY STORAGE-SYSTEMS ANALYSIS
R. W. Leigh Apr. 1981 9 p refs Presented at the Contractor's Inform. Exchange Meeting, Chicago, Apr. 1981
(Contract DE-AC02-76CH-00016)
(BNL-29405; CONF-810459-3) Avail: NTIS HC A02/MF A01

Systems analysis activities related to energy storage in solar applications are described, and the purpose, methods and, where available, the results of each study are summarized. Areas of investigation include storage of electrical and thermal energy in solar total energy systems, a theoretical investigation of the value of storage, and the national fuel displacement potential of semi-passive solar storage walls. The cost effectiveness of a spectrum of passive solar storage devices and the value of several possible improvements in these devices are also subjects of interest. DOE

N81-29662# Sandia Labs., Albuquerque, N. Mex.
COMPARATIVE ANALYSIS OF COMBINED FLAT-PLATE PV/T COLLECTORS WITH SEPARATE PHOTOVOLTAIC AND THERMAL COLLECTORS
E. R. Hoover 1981 6 p refs Presented at the 15th IEEE PV Specialists Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2217C; CONF-810526-3) Avail: NTIS HC A02/MF A01

The conditions under which a combined photovoltaic/thermal (PV/T) collector is more cost effective than separate flat-plate photovoltaic and thermal collectors were determined. The annual performance of the separate PV/T system and four different combined PV/T systems were simulated. Based on the equivalent electrical and thermal outputs and the 1986 DOE cost goal for PV modules (70 cents/Wp), the maximum allowable incremental cost to upgrade the conventional thermal collector to a combined PV/T collector was determined. For all of the

cases considered, the separate PV/T collectors are more cost effective than the combined PV/T collectors. DOE

N81-29683# Sandia Labs., Albuquerque, N. Mex.
THERMAL IMPEDANCE EFFECTS IN GaAs HIGH CONCENTRATION PHOTOVOLTAIC CELLS
R. J. Chaffin 1981 5 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2333C; CONF-810526-4) Avail: NTIS HC A02/MF A01

Heteroface GaAs cells were proposed for use at high concentration levels (up to 600 suns). Economic studies of photovoltaic arrays at high concentration have shown that efficiency increases of a few percent cell cost increases of 100 to 200% while maintaining the array cost at a constant $/Wp. Typical thermal heat sink designs will reduce cell efficiencies at high concentrations by similar or larger amounts. Measurements on typical GaAs assemblies are presented. These data show that improved thermal designs are needed to fully take advantage of concentrator economics at high insolations. DOE

N81-29684# Sandia Labs., Albuquerque, N. Mex.
DEVELOPMENT AND EVALUATION OF A LOW-COST PHOTOVOLTAIC CONCENTRATOR MODULE
B. D. Shafer, C. B. Stillwell, and H. Togami 1981 6 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1210C; CONF-810526-7) Avail: NTIS HC A02/MF A01

The module is 0.85 by 0.85 meters by 0.2 meters deep. It can be configured for stand alone applications of several hundred watts or used as a basic building block for multi-kilowatt systems. Measurements indicate an efficiency of 13.7% at 28 C cell temperature. The module has excellent potential for competitiveness in today's $5 to 10/watt market as well as the projected lower costs for future markets. DOE

N81-29566# Sandia Labs., Albuquerque, N. Mex.
COST EFFECTIVENESS OF CONCENTRATING PHOTOVOLTAIC-THERMAL (PVT) SYSTEMS VS. SIDE-BY-SIDE SYSTEMS FOR TWO INTERMEDIATE APPLICATIONS
M. Rios, Jr., M. W. Edenburn, and P. A. Allen 1981 10 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1219C; CONF-810526-6) Avail: NTIS HC A02/MF A01

Hour-by-hour simulations of the performance of three solar energy systems - concentrating photovoltaic-thermal (PVT), flat panel photovoltaic with conventional thermal (FPPV/CT) system, and flat panel photovoltaic with solar thermal (FPPV/ST) system were conducted. Life-cycle-cost analyses were then conducted for array sizes ranging from 31 k W sub p to 936 kW sub p. The three systems were compared to each other by computing the ratio of the annual cost of each system to the annual cost of conventional energy. It is concluded that, of the three systems analyzed, PVT potentially has the highest break-even costs with conventional energy; the cost effectiveness of PVT vs FPPV/CT is very strongly dependent on the ratios of direct normal to total solar availability; and at $1/W sub p ($84 sq m) for flat panel PV modules and $120/sq m for solar thermal collectors, PVT collectors can cost up to about $195/sq m for breakeven with FPPV/ST. DOE

N81-29568# General Electric Co., Schenectady, N. Y.
POINT-FOCUS CONCENTRATOR SOLAR CELL MOUNTS USING DIRECT-BONDED COPPER
H. F. Webster, N. F. Shepard (General Electric Co., Philadelphia, Pa.), and E. P. Jochym (General Electric Co., Syracuse, N.Y.) 1981 24 p refs Presented at 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-7111C; CONF-810526-5) Avail: NTIS HC A02/MF A01

A solar cell mount assembly was developed for use in 70 suns which will provide the cell with adequate cooling and electrical isolation over a long operating life. The assembly consisted of a copper to alumina to copper sandwich which was made by the direct bonding process. This sandwich was attached to the cell and the copper mounting stud by the use of a low fatigue solder. This mount was designed to be part of a system built to meet the 1980 cos. goal of $2.80 per watt of electrical output. DOE

N81-29587# Sandia Labs., Albuquerque, N. Mex. Solar Technical Liaison Div.
USE OF ALUMINUM IN SOLAR ENERGY
Robert P. Stromberg 1980 28 p Presented at the Aluminum Assoc. Alternate Energy Workshop, Washington, D.C., 8 Oct. 1980
(Contract DE-AC04-76DP-00789)
(SAND-81-0604C; CONF-8010178-1) Avail: NTIS HC A03/MF A01

Current solar hardware for electric power generation being tested or in place at some industrial plants was briefly reviewed. The use of aluminum in the solar industry and the economics of aluminum requirements in the industry as they currently exist are discussed broadly. Many photographs illustrate the presentation. DOE

N81-29588# Sandia Labs., Albuquerque, N. Mex. Photovoltaic Projects Div.
PHOTOVOLTAIC SYSTEM DEFINITION AND DEVELOPMENT PROJECT
Mar. 1981 230 p Abstracts of proceedings of 2nd Project Integration Meeting of the Sandia Photovoltaic Systems Definition and Development Proj., Albuquerque, N. Mex., 7-8 Apr. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-0823C; CONF-810453) Avail: NTIS HC A11/MF A01

The objectives of the project intgration meeting were to: overview the plans and strategy of the Department of Energy (DOE) Photovoltaic Program in the context of photovoltaic systems development; exchange information on ongoing work and related activities; and provide a means of coordinating project activities. This meeting emphasized balance of system technology development activities for grid-connected applications. Presentations covered application specific subsystem requirements, current cost and hardware data, and assessments of future development directions. Abstracts of the presentations are included. DOE

N81-29689# Sandia Labs., Albuquerque, N. Mex.
CHARACTERIZATION OF p+nn+ SILICON CONCENTRATOR SOLAR CELLS
R. D. Nasby, C. M. Garner, H. T. Weaver, F. W. Sexton, and J. L. Rodriguez 1981 6 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(SAND-80-2196C; CONF-810526-12) Avail: NTIS HC A02/MF A01

The conversion efficiency, temperature coefficients of performance parameters, and the linearity of the short circuit current with irradiance are reported for silicon p+nn+ concentrator solar cells of 0.3 ohm-cm base resistivity. Conversion efficiencies of 20 percent at 27 C were measured on the best cells over concentrations from 20 to 100 suns. A value of 0.26 percent/C was determined for the normalized temperature coefficient of efficiency for irradiance levels at which the efficiency was maximum. The deviation from linearity of the short circuit current irradiance was measured and found to be slightly superlinear in the multihundred-sun concentration range. Performance of cells with 1.0 and 10 ohm-cm base resistivities were also measured, and experimental and theoretical comparisons are made between the three cell types. DOE

N81-29573# Oklahoma State Univ., Stillwater. School of Technology.
DESIGN AND FIELD TESTING OF SOLAR-ASSISTED EARTH COILS Final Report, 1 Aug. 1978 - 31 Jan. 1981
J. E. Bose 1981 106 p
(Contracts DE-AS03-79CS-30210; EM-78-S-01-4257)
(DOE/CS-30120/T1) Avail: NTIS HC A06/MF A01

A nominal 1000-foot, 4-inch, PVC coil buried in a serpentine pattern is the heat source/sink for two commercial heat pump systems. This system is vented which allows the easy placement of thermocouples down its length to measure changes in temperature as well as changes in overall U values as a function of length. Integral to the earth coil is a 1000-gallon uninsulated water storage tank in which solar energy from 210 sq ft of solar collectors (single-glazed, metal absorber) can be added directly to the heat pump, circulated through the 1000-foot earth coil system, or added to an insulated storage tank for direct

transfer. Temperature ranges for this type of system at the four-foot level are from a nominal range of 780F to a low of 420F in the absence of heat rejection of absorption. The second type of earth coil was a vertical coil approximately 240 feet in length. The vertical heat exchanger consists of a 5-inch PVC pipe which is capped at both ends and pressurized at approximately 15 PSIG. This sealed and pressurized heat exchanger allows a low power pump to circulate water through both the ha... pump and vertical heat exchanger system. DOE

N81-29574# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
LOW-COST EVACUATED-TUBE SOLAR COLLECTOR. APPENDICES, VOLUME 2 Final Report, 15 Sep. 1978 - 31 May 1980
31 May 1980 392 p
(Contract EM-78-C-04-4226)
(DOE/CS-30133/T1-Vol-2) Avail: NTIS HC A17/MF A01

A low cost solar heat energy collector module and array was designed using the evacuated tube, selective absorber, air cooled concept. Glass tubing as used in fluorescent lamps with automatic sealing methods is a key feature of the evacuated tube design. A molded fiber glass concentrating reflector panel and sheet metal header assembly are proposed. Major design problems involved included the cost of materials and labor, thermal expansion and distortion problems, high stagnation and operating temperatures, isolation, thermal efficiency, sealing, joining, air pressure drop, and weight of the preassembled module. A cost of less than $5 per active square foot of collecting surface has been estimated for materials and labor of the module and its mounting frame. DOE

N81-29576# ECA, Inc., Woodridge, Ill.
ATMOSPHERIC CORROSION OF BATTEN AND ENCLOSURE MATERIALS FOR FLAT PLATE SOLAR COLLECTORS
Sep. 1980 38 p refs
(Contract W-31-109-eng-38)
(ANL/EES/TM-135) Avail: NTIS HC A03/MF A01

Sensors at nine test sites provided atmospheric data. Other data were obtained by analyzing corrosion samples that were exposed for varying periods of time. The results of the first test period are summarized. DOE

N81-29577# Automation Industries, Inc., Silver Spring, Md. Vibro Labs. Div.
SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION, OCTOBER 1979-APRIL 1980: BOND CONSTRUCTION, GLADSTONE, MISSOURI
E. N. Ashman 1980 84 p refs
(Contract DE-AC01-79CS-30027)
(SOLAR/1050-81/14) Avail: NTIS HC A05/MF A01

This active solar system uses 465 sq ft of liquid flat plate collectors and an 800-gallon steel tank for storage. The system was designed to provide 58% of the heating load and 85% of the hot water. Due to control and equipment problems, the system supplied 16% of the space heating and 48% of the domestic hot water requirements during times when the system operated. DOE

N81-29578# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR HELIO-THERMICS, INC., LOT 6 SINGLE FAMILY RESIDENCE; GREENVILLE, SOUTH CAROLINA
D. Moore 19 Mar. 1981 58 p
(Contract DE-AB01-78CS-31020)
(SOLAR/1025-81/50) Avail: NTIS HC A04/MF A01

An instrumented single family residence in Greenville, South Carolina, has approximately 1088 square feet on conditioned space. Solar energy is used for space heating the home and preheating domestic and water (DHW). Solar energy enters the attic through a 416 square foot aperture which is double glazed with corrugated, translucent, fiberglass reinforced, acrylic panels. Warm air accumulates in the peak of the attic roof and circulates through the conditioned space or through storage by an air handler. Solar energy is stored in an 870 cubic foot storage bin containing 85,460 pounds of crushed rock located under the house. cold water is preheated in the attic by thermosiphoning water from the 80 gallon preheat tank through a manifold system of copper tubes. These tubes are attached to black sheet metal plates. Preheated city water is stored in the preheat tank and supplied, on demand, to a conventional 80 gallon DHW tank. When solar energy is insufficient to satisfy the space heating load, a water to air heat exchanger in the hot air supply duct provides auxiliary energy for space heating. A gas fired water heater provides auxiliary energy for the water to air heat exchanger and the DHW. DOE

N81-29579# G K Systems, Inc., Westlake Village, Calif.
TRACKING INSTRUMENT AND CONTROL FOR SOLAR CONCENTRATORS Final Technical Report, Oct. 1979 - Jan. 1981
John Gray and John Kuhlman 31 Jan. 1981 176 p
(Contract DE-AC01-79ET-21109)
(DOE/ET-21109/T1) Avail: NTIS HC A09/MF A01

The tracker users a single photo sensor, and a rotating aperature to obtain tracking accuracies better than 1.5 mrads (0.1 degs). Peak signal detection is used to eliminate tracking of false sources, i.e., clouds, etc. A prism is employed to obtain an extended field of view (150 degs axially - 360 degs radially). The tracker digitally measures the Sun's displacement angle relative to the concentrator axis, and repositions it incrementally. This arrangement permits the use of low cost nonservo motors. The local controller contains microprocessor based electronics, incorporating digital signal processing. DOE

N81-29581# Martin Marietta Corp., Denver, Colo.
SOLPAS: PASSIVE SOLAR ALGORITHMS. USER'S MANUAL
Mar. 1981 189 p
(Contract DE-AC01-78CS-35243)
(MCR-81-543) Avail: NTIS HC A09/MF A01

This users' guide documents library of passive solar heating subroutines that are compatible with the generalized MITAS thermal network analyzer. The objective of the SOLPAS activity has been to develop and document the essential routines needed to perform passive solar simulations with the existing MITAS program. Several example models are described that could be adapted easily to specific user applications. The following are included: SOLPAS basic structure, alphabetical listing of SOLPAS routines; selected MITAS subroutines, and SOLPAS examples. DOE

N81-29583# Sandia Labs., Albuquerque, N. Mex. Systems Analysis Div.
EXPERIMENTAL PARABOLIC TROUGH COLLECTOR PERFORMANCE CHARACTERIZATION
L. L. Lukens May 1981 20 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0313) Avail: NTIS HC A02/MF A01

Experimental data from the Collector Module Test Facility at Sandia National Laboratories, Albuquerque, are used to develop a collector performance model and characterize three parabolic trough solar collectors. The independent variables used in the model are selected and fitted to the experimental data using a multiple linear regression technique. The collector model developed accounts for optical performance, including incident angle effects and thermal losses, both linear and nonlinear. DOE

N81-29591# Texas Technological Univ., Lubbock.
CELL STRING MODEL WITH MIRROR GAP SHADING FOR A PARABOLIC-TROUGH PHOTOVOLTAIC COLLECTOR
J. R. Burns and M. W. Edenburn Apr. 1981 44 p Prepared in cooperation with Sandia National Labs.
(Contract DE-AC04-76DP-00789)
(SAND-81-0069) Avail: NTIS HC A03/MF A01

A model is described of a photovoltaic cell string which is illuminated by a parabolic trough reflector. The model shows what effect reflector gaps have on cell illumination and how this effect influence shunting of dioded strings for various angles of solar incidence. The model was formulated to study diode string length and determine how best to maximize power under variant incidence angles. Qualitative results suggest that a nonuniform diodeing arrangement would minimize power losses due to shunting; that small strings should be used where shading is most probable; and, for north-south axis collectors, that the receiver should be moved northward to avoid end losses and end shading of the receiver. DOE

N81-29582# Sandia Labs., Albuquerque, N. Mex. Automated Test Systems Development Div.
ON-SITE DATA ACQUISITION SYSTEM FOR PHOTOVOL-

TAIC APPLICATIONS EXPERIMENTS
Thomas L. Evans Apr. 1981 53 p
(Contract DE-AC04-76DP-00789)
(SAND-81-0897) Avail: NTIS HC A04/MF A01

This system is fully automated, and the acquired data is transmitted periodically to a remote Data Reduction Center for analysis and reporting. The data acquisition system can also be used for on site data presentations to facilitate photovoltaic system start up and prove in. DOE

N81-29599# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR INDUSTRIAL PROCESS HEAT: A STUDY OF APPLICATIONS AND ATTITUDES Final Report
V. Wilson Apr. 1981 75 p refs Prepared in cooperation with Insights West Inc., Los Angeles, Calif.
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-98348-1) Avail: NTIS HC A04/MF A01

Data were gathered through site visits to 100 industrial plants. The site specific data suggests several possible near term market opportunities for solar thermal energy systems. Plants using electricity as their primary fuel for industrial process heat were identified, on the basis of their high fuel prices, as attractive early entry markets for solar energy. Additional opportunities were reflected in plants that had accomplished much of their conservation plans, or had sizeable percentages of their operating budgets committed to energy expenses. A suitability analysis identified eleven industrial plants as highly suitable for solar thermal applications, they included producers of fluid milk, pottery, canned and bottled soft drinks, fabricated structural metal, refined petroleum, aluminum cans, chrome and nickel plating and stamped frame metal and metal finishings. DOE

N81-29600# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ANALYSIS AND TEST OF LINE-COMMUTATED INVERTERS FOR USE IN RESIDENTIAL PHOTOVOLTAIC POWER SYSTEMS
E. E. Landsman 1981 9 p refs Presented at 15th IEEE PV Specialists Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/127; CONF-810526-2) Avail: NTIS HC A02/MF A01

The line-commutated inverter is a phase-controlled rectifier operating in the regenerative mode. Existing analyses emphasize rectifier mode of operation and there has been minimal treatment of the regenerative mode. A detailed theoretical analysis coupled with observation of operating inverters is leading to a better understanding of inverter operation which may lead to improvement in power factor and a reduction of harmonic currents. The normalized results of the theoretical analysis, test data, and waveforms are presented. DOE

N81-29601# Mueller Associates, Inc., Baltimore, Md.
ECONOMIC ANALYSIS OF COMMERCIAL SOLAR WATER-HEATING SYSTEMS
23 Sep. 1980 71 p
(Contract W-31-109-eng-38)
(ANL-K-80-55; MAI-Rept-203) Avail: NTIS HC A04/MF A01

The economic performance of solar energy systems is described through the use of Cash Flow Diagrams. The economic performance of solar energy systems is described through the calculation of equivalent Return-On-Investment (ROI). Appendices are included that enable one to calculate the ROI for any particular solar hot water system investment. DOE

N81-29602# Eisenstadt (Melvin) and Associates, Inc., Albuquerque, N. Mex.
PERFORMANCE WARRANTIES FOR RESIDENTIAL AND LIGHT-COMMERCIAL PHOTOVOLTAIC SYSTEMS
Melvin Eisenstadt Apr. 1981 101 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-7008) Avail: NTIS HC A06/MF A01

The warranty law and its liability is examined. The Uniform Commercial Code and the Federal Magnuson Moss Warranty Act are analyzed in regard to photovoltaic (PV) systems. Warranties written, oral, and those implied by law are discussed. The potential liabilities of manufacturers and sellers of PV equipment are investigated and legal methods to limit such liabilities are discussed. The PV warranties cover primarily materials, workmanship, and electrical performance; all are highly defective legally, none conform with the Magnuson-Moss Warranty Act, and potential liability under the Uniform commercial code is great. It is concluded that the PV industry lacks understanding of warranty law and its liabilities. E.A.K.

N81-29603# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PERFORMANCE EVALUATION OF A REFRIGERANT-CHARGED THERMOSYPHON SOLAR DHW SYSTEM
Robert Farrington, Michael DeAngelis, Louise Morrison, and Douglas Dougherty Apr. 1981 7 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC02-77CH-00178)
(SERI/TP-721-1140; CONF-810509-21) Avail: NTIS HC A02/MF A01

Refrigerant-charged passive solar domestic hot water (SDHW) systems, which can be installed even in freezing climates, may achieve the high performance and reliability of direct thermosyphon systems. The prototype was installed in a single-family residence using a stabilized R-11 as the heat transfer fluid. A system analysis was performed based on measured data. The analysis method and preliminary results, which indicate that there is reason to be optimistic about this type of system are discussed. DOE

N81-29608# Department of Agriculture, Clay Center, Nev. Meat Animal Research Center.
ANAEROBIC FERMENTATION OF BEEF CATTLE MANURE Final Report
A. G. Hashimoto, Y. R. Chen, and V. H. Varel Jan. 1981 76 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-98372-1) Avail: NTIS HC A05/MF A01

The conversion of livestock manure and crop residues into methane and a high protein feed ingredient by thermophilic anaerobic fermentation is summarized. The major biological and operational factors involved in methanogenesis are discussed, and a kinetic model that describes the fermentation process is presented. Substrate biodegradability, fermentation temperature, and influent substrate concentration to have significant effects on CH4 production rate. Assessment of the energy requirements for anaerobic fermentation systems showed that the major energy requirement for a thermophilic system was for maintaining the fermenter temperature. The next major energy consumption was due to the mixing of the influent slurry and fermenter liquor. An approach to optimizing anaerobic fermenter s by selecting design criteria that maximize the net energy production per unit cost is presented. DOE

N81-29609# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.
SOLAR REPOWERING SYSTEM FOR TEXAS ELECTRIC SERVICE COMPANY PERMIAN BASIN STEAM ELECTRIC STATION UNIT NO. 5, EXECUTIVE SUMMARY Final Report, 27 Sep. 1979 - 15 Jul. 1980
15 Jul. 1980 35 p refs
(Contract DE-AC03-76SF-10607)
(DOE/SF-10607/T1; ESG-80-22) Avail: NTIS HC A03/MF A01

The conceptual design and economic assessment of a sodium-cooled, solar central receiver repowering system are described. As expected, the economic assessment of the specific concept for that site indicates that the cost of energy is greater than that resulting from the burning of natural gas alone in the existing plant (principally as a result of the current cost of heliostats and the scheduled retirement date of Unit No. 5). Favorable economics for similar types of plants can be projected for the future. The annual fuel savings are equivalent to 218,500 barrels of crude oil, with a total dollar value of $21.5 M and $93.8 M for a 7-year life and a 25-year life, respectively. However, it has also been found that favorable interpretations of the Fuel Use Act and an improved regulatory climate will be necessary for this economic viability to be reached. DOE

N81-29610# Los Alamos Scientific Lab., N. Mex.
PHYSICS OF PASSIVE SOLAR BUILDINGS
J. D. Balcomb 1981 7 p refs Presented at Am. Soc. for Engr. Educ. Ann. Conf., Los Angeles, 22 Jun. 1981
(Contract W-7405-eng-36)
(LA-UR-81-903; CONF-810627-1) Avail: NTIS HC A02/MF A01

Methods to characterize and analyze passive solar buildings are discussed. Simplifying assumptions which make this analysis tractable without compromising significant accuracy or loss of insight into the basic physics of the situation are described. The overall nature of the mathematical simulation approach and validation procedures based on data from test rooms and monitored buildings are outlined. Issues of thermal comfort, simplified methods of analysis based on correlation procedures are reported and the nature of the economic conservation solar optimization process is explored. DOE

N81-29613# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
LOW-COST PASSIVE SOLAR-RETROFIT OPTIONS FOR MOBILE HOMES
S. Brant, Michael Holtz, and Mark Tasker Mar. 1981 7 p refs Presented at the AS/ISES Ann. Meeting, Philadelphia, 26-30 May 1981
(Contract EG-77-C-01-4042)
(SERI/TP-721-1138; CONF-810509-22) Avail: NTIS HC A02/MF A01

Passive solar heating and cooling retrofit options can significantly reduce the energy consumption of new and existing mobile homes. The initial efforts of the Solar Energy Research Institute to explore the solar potential for the existing stock of mobile homes and those in the production stage are described. DOE

N81-29626# Sandia Labs., Albuquerque, N. Mex.
INTRODUCING THE NEW PHOTOVOLTAIC DATA REDUCTION CENTER
H. D. Pruett, J. T. Muldoon (Boeing Computer Services, Seattle, Wash.), and H. Z. Kriloff (Boeing Computer Services, Seattle, Wash.) 1981 12 p refs Presented at Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2578C; CONF-810509-3) Avail: NTIS HC A02/MF A01

The center archives the data, analyzes it, and generates monthly performance reports of potential interest to researchers, designers, and other data users. Due to the rapidly evolving nature of the photovoltaic field, particular emphasis was placed on making reports available in a timely manner, and on making the DRC structure flexible enough to adapt to changing requirements. The overall structure incorporated in the data and information system is described, details of the hardware and software utilized are presented, and the output product (monthly performance reports) is illustrated with examples taken from experimental sites that are now operational. DOE

N81-29627# Sandia Labs., Albuquerque, N. Mex.
THE CVD ZrB2 AS A SELECTIVE SOLAR ABSORBER
E. Randich and D. D. Allred (Energy Conversion Devices, Troy, Mich.) 1981 12 p refs Presented at Intern. Conf. on Metallurgical Coatings, San Francisco, 6-10 Apr. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-2176C; CONF-810425-2) Avail: NTIS HC A02/MF A01

Coatings of ZrB2 and TiB2 for photothermal solar absorber applications were prepared using chemical vapor deposition (CVD) techniques. Oxidation tests suggest a maximum temperature limit for air exposure of 600 K for TiB2 and 800 K for ZrB2. Both materials exhibit innate spectral selectivity with emittance at 375 K ranging from 0.06 to 0.09 and solar absorptance for ZrB2 ranging from 0.67 to 0.77 and solar absorptance for TiB2 ranging from 0.46 to 0.58. ZrB2 has better solar selectivity and more desirable oxidation behavior than TiB2. A 0.071 micrometer antireflection coating of Si3N4 deposited on the ZrB2 coating leads to an increase in absorptance from 0.77 to 0.93, while the emittance remains unchanged. DOE

N81-30109# Johns Hopkins Univ., Laurel, Md.
US COAST GUARD STUDY ON SOLAR POWERED AIDS TO NAVIGATION (SPAN)
W. E. Allen and J. E. Tarr Feb. 1981 107 p refs Sponsored in part by Coast Guard
(PB81-190233; JHU/APL-SR-81-3) Avail: NTIS HC A06/MF A01 CSCL 17G

This study evaluates a system using a secondary battery, recharged daily to the extent practicable by a photovoltaic solar panel mounted on the aid. Factors affecting performance of this system are discussed. Nickel cadmium and lead acid batteries are evaluated and compared as energy storage elements, considering such factors as cycle life, allowable depth of discharge, and cost. Candidate charge regulators are also evaluated. Included in this report is a discussion of areas requiring further research. GRA

N81-30225# California Univ., Livermore. Lawrence Livermore Lab.
PROPOSED SOLAR-FURNACE STUDY OF ZINC SULFATE DECOMPOSITION
Oscar H. Krikorian and Pamela K. Shell 16 Apr. 1981 7 p refs Presented at the Solar Thermal Test Facilities Users Association Ann. Business and Technical Meeting, Pasadena, Calif., 20-24 Apr. 1981
(Contract W-7405-eng-48)
(UCRL-85743; CONF-810469-1) Avail: NTIS HC A02/MF A01

A solar furnace study of zinc sulfate is proposed. The advantages of the high temperatures and rapid heating rates provided by solar collectors for the decomposition of zinc sulfate. The use of a rotary kiln designed to improve the efficiency in working with solids that have low absorbtivities, such as solid sulfates, is planned. The overall goal is to establish the applicability of solar central receivers to thermochemical cycles that can use solid state sulfate decomposition as the high temperature step. DOE

N81-30255# Giner, Inc., Waltham, Mass.
CORROSION CONTROL MANUAL FOR ALUMINUM SOLAR-COLLECTOR PANELS USING GLYCOL-WATER SOLUTIONS FOR HEAT TRANSFER/FREEZE PROTECTION
May 1981 13 p
(Contract DE-AC04-79CS-31072)
(DOE/CS-31072/1) Avail: NTIS HC A02/MF A01

Types of general and localized corrosion of aluminum are described, and factors that initiate or accelerate corrosion are discussed. Recommendations are made for controlling corrosion of aluminum. Aluminum corrosion inhibitors are listed for use with ethylene glycol and propylene glycol, and instructions are given for preparing inhibited glycols. DOE

N81-30352 Rice Univ., Houston, Tex.
THE PHOTOTRON Ph.D. Thesis
Sedgwick Lewis Simons, Jr. 1981 107 p
Avail: Univ. Microfilms Order No. 8116995

A potentially more efficient mode of operation in which the electron period of motion is approximately half of the radio frequency (RF) period is considered. Computer plots of the electron trajectories reveal that unlike the multi-pass mode, this mode exhibits a genuine electron bunching process. Since these modes operate at low bias voltages an investigation of space charge effects and electron emisson energy was made. Theoretical results from a computer program based on an analysis by Guernsey and Fu show that potentials within the phototron can be dramatically reshaped by space charge, altering electron motion in the phototron and filtering show electrons out of the beam. Experimental measurements of the electron energy spectra document this filtering effect. Efficiency calculations show that the greatest restriction on overall efficiency is due to the photocathode itself. The test model tubes show a cathode efficiency of only about 1%, but better materials may improve this value to about 10%. If the efficiency of the conversion of dc to RF in the phototron can also be improved, an overall device efficiency of 1% for the conversion of sunlight into RF may be realized in the near future. Dissert. Abstr.

N81-30515*# Solarex Corp., Rockville, Md.
A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT (MEPSDU) Quarterly Report, 1 Mar. - 31 May 1981
31 May 1981 52 p refs Sponsored by NASA and DOE Prepared for JPL
(Contract JPL-955902)
(NASA-CR-164673; DOE/JPL-955902-81/2; JPL-9950572; QR-2) Avail: NTIS HC A04/MF A01 CSCL 10A

The purpose of this program is to demonstrate the technical readiness of a cost effective process sequence that has the

potential for the production of flat plate photovoltaic modules which met the price goal in 1986 of $.70 or less per watt peak. Program efforts included: preliminary design review, preliminary cell fabrication using the proposed process sequence, verification of sandblasting back cleanup, study of resist parameters, evaluation of pull strength of the proposed metallization, measurement of contact resistance of Electroless Ni contacts, optimization of process parameter, design of the MEPSDU module, identification and testing of insulator tapes, development of a lamination process sequence, identification, discussions, demonstrations and visits with candidate equipment vendors, evaluation of proposals for tabbing and stringing machine. Author

N81-30516*# MB Associates, San Ramon, Calif.
PROCESS DEVELOPMENT FOR AUTOMATED SOLAR CELL AND MODULE PRODUCTION. TASK 4: AUTOMATED ARRAY ASSEMBLY Quarterly Report
John J. Hagerty 15 Jul. 1981 42 p
(Contract JPL-955699)
(NASA-CR-164682; DOE/JPL-955699-81/04; JPL-9950574; QR-4) Avail: NTIS HC A03/MF A01 CSCL 10A

Progress in the development of automated solar cell and module production is reported. The unimate robot is programmed for the final 35 cell pattern to be used in the fabrication of the deliverable modules. The mechanical construction of the automated lamination station and final assembly station phases are completed and the first operational testing is underway. The final controlling program is written and optimized. The glass reinforced concrete (GRC) panels to be used for testing and deliverables are in production. Test routines are grouped together and defined to produce the final control program. E.A.K.

N81-30519*# Union Carbide Corp., Oak Ridge, Tenn.
LOW COST SOLAR ARAY PROJECT: EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT FOR PRODUCING SEMICONDUCTOR-GRADE SILICON USING THE SILANE-TO-SILICON PROCESS Quarterly Progress Report, Apr. - Jun. 1981
Jun. 1981 71 p Sponsored by NASA and DOE Prepared for JPL
(Contract JPL-954334)
(NASA-CR-164680; DOE/JPL-954334-19; JPL-9950577) Avail: NTIS HC A04/MF A01 CSCL 10A

This phase consists of the engineering design, fabrication, assembly, operation, economic analysis, and process support R&D for an Experimental Process System Development Unit (EPSDU). The mechanical bid package was issued and the bid responses are under evaluation. Similarly, the electrical bid package was issued, however, responses are not yet due. The majority of all equipment is on order or has been received at the EPSDU site. The pyrolysis/consolidation process design package was issued. Preparation of process and instrumentation diagram for the free-space reactor was started. In the area of melting/consolidation, Kayex successfully melted chunk silicon and have produced silicon shot. The free-space reactor powder was successfully transported pneumatically from a storage bin to the auger feeder twenty-five feet up and was melted. The fluid-bed PDU has successfully operated at silane feed concentrations up to 21%. The writing of the operating manual has started. Overall, the design phase is nearing completion. Author

N81-30523*# Wyle Labs., Inc., Huntsville, Ala. Solar Energy Systems Div.
DESIGN DATA PACKAGE AND OPERATING PROCEDURES FOR MSFC SOLAR SIMULATOR TEST FACILITY
Jun. 1981 174 p refs Sponsored in part by DOE
(Contract DEN8-6)
(NASA-CR-161825; WYLE-TR-531-48) Avail: NTIS HC A08/MF A01 CSCL 10A

Design and operational data for the solar simulator test facility are reviewed. The primary goal of the facility is to evaluate the performance capability and worst case failure modes of collectors, which utilize either air or liquid transport media. The facility simulates environmental parameters such as solar radiation intensity, solar spectrum, collimation, uniformity, and solar attitude. The facility also simulates wind conditions of velocity and direction, solar system conditions imposed on the collector, collector fluid inlet temperature, and geometric factors of collector tilt and azimuth angles. Testing the simulator provides collector efficiency data, collector time constant, incident angle modifier data, and stagnation temperature values. E.A.K.

N81-30525*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PARABOLIC DISH SOLAR THERMAL POWER ANNUAL PROGRAM REVIEW PROCEEDINGS
Herb J. Holbeck 1 May 1981 277 p refs Proceedings of conf. held in Pasadena, Calif., 13-15 Jan. 1981
(Contracts NAS7-100; DE-ATC4-81AL-16228)
(NASA-CR-164696; JPL-Pub-81-44; DOE/JPL-1060-46; JPL-5105-83) Avail: NTIS HC A13/MF A01 CSCL 10A

The development and testing of concentrators, receivers, and power conversion units are reported. System design and development for engineering experiments are described. Economic analysis and market assessments for advanced development activities are discussed. Technology development issues and application/user needs are highlighted. For individual titles, see N81-30526 through N81-30557.

N81-30526*# Ford Aerospace and Communications Corp., Newport Beach, Calif.
THE SCSE ORGANIC RANKINE ENGINE
Frank P. Boda *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 5-9

Avail: NTIS HC A13/MF A01 CSCL 10B

The engine is the heart of a Power Conversion Subsystem (PCS) located at the focal point of a sun-tracking parabolic dish concentrator. The ORC engine employs a single-stage axial-flow turbine driving a high speed alternator to produce up to 25 kW electrical output at the focus of each dish. The organic working fluid is toluene, circulating in a closed-loop system at temperatures up to 400 C (750 F). Design parameters, system description, predicted performance and program status are described. T.M.

N81-30527*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JAY CARTER ENTERPRISES, INCORPORATED STEAM ENGINE
In JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 11-15 refs

Avail: NTIS HC A13/MF A01 CSCL 10B

The Small Community Solar Thermal Power Experiment (SCSE) selected an organic rankine cycle (ORC) engine driving a high speed permanent magnet alternator (PMA) as the baseline power conversion subsystem (PCS) design. The back-up conceptual PCS design is a steam engine driving an induction alternator delivering power directly to the grid. The development of the automotive reciprocating simple rankine cycle steam engine and how an engine of similar design might be incorporated into the SCSE is discussed. A description of the third generation automotive engine is included along with some preliminary test data. Tests were conducted with the third generation engine driving an induction alternator delivering power directly to the grid. The purpose of these tests is to further verify the effects of expander inlet temperature, input thermal power level, expansion ratio, and other parameters affecting engine performance to aid in the development of an SCSE PCS. T.M.

N81-30528*# Foster-Miller Associates, Inc., Waltham, Mass.
STEAM ENGINE RESEARCH FOR SOLAR PARABOLIC DISH
Roger L. Demler *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Proc. 1 May 1981 p 17-22 refs

Avail: NTIS HC A13/MF A01 CSCL 10B

The parabolic dish solar concentrator provides an opportunity to generate high grade energy in a modular system. Most of the capital is projected to be in the dish and its installation. Assurance of a high production demand of a standard dish could lead to dramatic cost reductions. High production volume in turn depends upon maximum application flexibility by providing energy output options, e.g., heat, electricity, chemicals and combinations thereof. Subsets of these options include energy storage and combustion assist. A steam engine design and experimental program is described which investigate the efficiency potential of a small 25 kW compound reheat cycle piston engine. An engine efficiency of 35 percent is estimated for a 700 C steam temperature from the solar receiver. T.M.

N81-30629*# Garrett Turbine Engine Co., Phoenix, Ariz.
SOLAR BRAYTON ENGINE/ALTERNATOR SET
L. Six and R. Elkins *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 23-35

Avail: NTIS HC A13/MF A01 CSCL 10B

Work on the Mod 0 solar Brayton engine/alternator set is redirected to utilize solarized components of the automotive advanced gas turbine (AGT). The new configuration is referred to as the Mod I. Commercialization of solar Brayton engines thus should be enhanced not only by relating the design to an engine expected to reach the high quantity, low cost production rates associated with the automotive market, but also by the potential the AGT components provide for growth of efficiency and power rating. This growth would be achieved through use of ceramics in later versions making operation possible at temperatures up to 2500 F. The longer program duration and higher cost of the Mod I is considered. T.M.

N81-30630*# United Sterling, Inc. Alexandria, Va. Concept Analysis Dept.
FIRST PHASE TESTING OF SOLAR THERMAL ENGINE AT UNITED STIRLING
Worth Percival and Hans-Goeran Nelving *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 37-44 refs

Avail: NTIS HC A13/MF A01 CSCL 10B

The objective of the program is to demonstrate that the Stirling engine is a practical efficient and reliable energy converter when integrated with a parabolic dish concentrator, and that it has the potential of being cost competitive with fossil fueled electric generating systems of today. The engine, with its receiver (solar heat exchanger), alternator and control system, is described. T.M.

N81-30631*# Fairchild Stratos Corp., Manhattan Beach, Calif.
NON-HEAT PIPE RECEIVER/P-40 STIRLING ENGINE
Richard A. Haglund *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 47-50

Avail: NTIS HC A13/MF A01 CSCL 10A

The technology for a full-up hybrid dish-Stirling Solar Thermal Power system is discussed. Overall solar-to-electric efficiency for the dish-Stirling system demonstration is approximately 30%. Hybrid operation is provided by fossil fuel combustion augmentation, which enables the Stirling engine to operate continuously at constant speed and power, regardless of insolation level, thus providing the capability to operate on cloudy days and at night. T.M.

N81-30632*# General Electric Co., Evendale, Ohio. Advanced Energy Programs Dept.
HEAT PIPE SOLAR RECEIVER WITH THERMAL ENERGY STORAGE
W. F. Zimmerman *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 51-56

Avail: NTIS HC A13/MF A01 CSCL 10A

An HPSR Stirling engine generator system featuring latent heat thermal energy storge, excellent thermal stability and self regulating, effective thermal transport at low system delta T is described. The system was supported by component technology testing of heat pipes and of thermal storage and energy transport models which define the expected performance of the system. Preliminary and detailed design efforts were completed and manufacturing of HPSR components has begun. T.M.

N81-30633*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE DEVELOPMENT OF AN 85-kW (THERMAL) AIR BRAYTON RECEIVER
M. Greevan (AiResearch Manufacturing Co., Torrance, Calif.) and William Owen *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 57-65

Avail: NTIS HC A13/MF A01 CSCL 10A

The results of the program from its inception through December 1980 are presented. The design requirements, concept, and significant analysis upon which the receiver is based are described. The fabrication processes that have been utilized in the construction of the prototype receivers at the test station are summarized. The test and evaluation phase at the Parabolic Dish Test Site are described. T.M.

N81-30634*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE DEVELOPMENT OF AN 85-kW (THERMAL) STEAM RANKINE SOLAR RECEIVER
Clifford C. Wright (AiResearch Manufacturing Co., Torrance, Calif.) and Herman Bank *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 67-74 refs

Avail: NTIS HC A14/MF A01 CSCL 10A

The receiver is a once-through monotube boiler designed for steam/electric and process steam applications at pressures up to 17.24 MPa (2500 psia) and temperatures up to 704 C (1300 F). The unit is 76.2 cm (30.0 in.) in diameter and 95.8 cm (37.7 in.) in length; it weighs 220 kg (485 lb). Its heat transfer surface, which is 45.7 cm (18 in.) in diameter by 57 cm (22.4 in.) long, is an Inconel 625, cylindrical, tube-coil assembly composed of primary and reheat sections. A test unit was successfully operated at up to 6.9 MPa (1000 psia) and 704 C (1300 F) with solar input from a 11-m-dia parabolic dish concentrator. T.M.

N81-30635*# Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div.
ORGANIC RANKINE CYCLE RECEIVER DEVELOPMENT
Harold J. Haskins *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 75-79 ref

Avail: NTIS HC A13/MF A01 CSCL 10A

The selected receiver concept is a direct-heated, once-through, monotube boiler operated at supercritical pressure. The cavity is formed by a cylindrical copper shell and backwall, with stainless steel tubing brazed to the outside surface. This core is surrounded by lightweight refractory insulation, load-bearing struts, and an outer case. The aperture plate is made of copper to provide long life by conduction and reradiation of heat away from the aperture lip. The receiver thermal efficiency is estimated to be 97 percent at rated conditions (energy transferred to toluene divided by energy incident on aperture opening). Development of the core manufacturing and corrosion protection methods is complete. T.M.

N81-30636*# General Electric Co., Philadelphia, Pa.
SOLAR THERMAL PARABOLIC DISH ENERGY APPLICATIONS
Walter Pijawka *In* JPL Parabolic Dish Solar Thermal Ann. Program Rev. Proc. 1 May 1981 p 87-106

Avail: NTIS HC A13/MF A01 CSCL 10A

Vu-graphs are presented that show that applications are a viable distributed renewable power generation option. Quality energy can be produced in the form of electricity and high temperature heat. Modular systems are described that can be distributed to new or existing plants and that are mass producible with the associated economies of production. T.M.

N81-30637*# Ford Aerospace and Communications Corp., Newport Beach, Calif.
STATUS OF THE CURRENT PARABOLIC DISH TECHNOLOGY
Calhoun Sumrall *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 107-115

Avail: NTIS HC A13/MF A01 CSCL 10B

Vu-graphs are presented that show that point focus distributed receiver distributed generation systems are cost competitive with current utilities. System cost caveats and typical power module costs are described. Major problems inhibiting commercialization of the parabolic dish technology were reviewed. T.M.

N81-30638*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CHARACTERIZATION OF POINT FOCUSING TEST BED CONCENTRATORS AT JPL
Donald J. Starkey *In its* Parabolic Dish Solar Thermal Power

Ann. Program Rev. Proc. 1 May 1981 p 135-142 Sponsored in part by DOE
Avail: NTIS HC A13/MF A01 CSCL 10A

The characterization data were measured using both a flux mapper and a cold water calorimeter. The flux mapper uses a Kendall Radiometer as the sensing device. It is mounted on an x, y, z motor-driven positioning mechanism that allows the sensor to take an x-y flux raster at several Z planes in the vicinity of the concentrators nominal focal plane. Various concepts were tried to protect the concentrator structure from being damaged by the Sun's energy during sun acquisition and deacquisition. A description of both the passive and active protective systems is presented. T.M.

N81-30539*# General Electric Co., Philadelphia, Pa.
GENERAL ELECTRIC POINT FOCUS SOLAR CONCENTRATOR STATUS
J. Zimmerman *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 143-147 ref

Avail: NTIS HC A13/MF A01 CSCL 10A

The concentrator design approach evolved by a systemmatic process of examining the operating requirements particular to the solar application, minimizing material content through detail structural design and structurally efficient subsystem features, and utilizing materials and processes compatible with high volume production techniques. The design approach, the present concentrator configuration and the status of the hardware development are described. T.M.

N81-30542*# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT AND TESTING OF THE SHENANDOAH COLLECTOR
George S. Kinoshita *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 161-170 Sponsored by DOE
(SAND-81-0028A) Avail: NTIS HC A13/MF A01 CSCL 10A

The test and development of the 7-meter Shenandoah parabolic dish collector incorporating an FEK-244 film reflective surface and cavity receiver are described. Four prototypes tested in the midtemperature Solar System Test Facility indicate, with changes incorporated from these development tests, that the improvements should lead to predicted performance levels in the production collectors. Author

N81-30543*# Power Kinetics, Inc., Troy, N.Y.
FRESNEL CONCENTRATING COLLECTOR
William Rogers, David Borton, Mark Rice, and Robert Rogers *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 171-178

Avail: NTIS HC A13/MF A01 CSCL 10A

An advanced point focusing solar technology demonstrated potential for near term commercialization as a renewable energy technology. The design features combine to produce a highly efficient, low cost, safe, adaptable, durable system which is simple to manufacture, install and maintain. S.F.

N81-30544*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SMALL COMMUNITY SOLAR THERMAL POWER EXPERIMENT
Taras Kiceniuk *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 187-189

Avail: NTIS HC A13/MF A01 CSCL 10A

Contractors were asked to develop a preferred system concept, to perform sensitivity analyses, and to outline recommended approaches for the follow-on design program of a one-megawatt solar thermal demonstration plant. The systems recommended by the contractors in each of the categories were: (1) McDonnell-Douglas Astronautics Company: Central tower with field of south-facing heliostats; (2) General Electric Company: Field of parabolic dishes with steam piped to a central turbine-generator unit; and (3) Ford Aerospace and Communications Corporation: Field of parabolic dishes with a Stirling cycle engine/generator unit at the focus of each dish. A description of each of the proposed experimental plants is given. S.F.

N81-30545*# Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div.
DEVELOPMENT OF THE SMALL COMMUNITY SOLAR POWER SYSTEM
Robert H. Babbe *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 191-196

(Contract JPL-955637)
Avail: NTIS HC A13/MF A01 CSCL 10A

The status of the Small Community Solar Thermal Power Experiment is presented. Activities on the Phase 2 single/module development effort are presented, together with plans for the Phase 3 1 MWe demonstration plant. A description of the various subsystems and components is given with emphasis on the unmanned microprocessor based plant control subsystem. Latest performance figures are given for the 1 MWe plant, based on 56 power modules, each consisting of a 12m low cost concentrator, a cavity receiver, a Rankine power conversion subsystem and a ground mounted solid-state rectifier. Overall plant efficiency at rated conditions is 15.8 percent. Advanced glass concentrator designs yield 20 percent overall efficiencies. S.F.

N81-30546*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SITE PARTICIPATION IN THE SMALL COMMUNITY EXPERIMENT
Herb J. Holbeck and Merrilee Fellows *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 197-204
Avail: NTIS HC A13/MF A01 CSCL 10A

The Small Community Solar Thermal Experiment, planned to test a small, developmental solar thermal power plant in a small community application, is assessed. The baseline plan is to install a field of parabolic dishes with distributed generation to provide 1 MWe of experimental power. Participation by the site proposer is an integral element of the experiment; the proposer will provide a ten-acre site, a connection to the electrical distributional system servin the small community, and various services. In addition to the primary participant, site study efforts may be pursued at as many as five alternative sites. S.F.

N81-30547*# Los Alamos Scientific Lab., N. Mex.
DEFINITIVE DESIGN OF THE SOLAR TOTAL ENERGY LARGE-SCALE EXPERIMENT AT SHENANDOAH, GEORGIA
R. W. Hunke and J. A. Leonard *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 205-208 Sponsored by DOE
(SAND-81-0029A) Avail: NTIS HC A13/MF A01 CSCL 10A

Construction of a Solar Total Energy Large Scale Experiment at Shenandoah, Georgia, is described. The Solar Total Energy System (STES) is designed with capacity to supply electricity and thermal energy to a knitwear plant at the Shenandoah site. The system will provide 400 kilowatts electrical and 3.5 megawatts thermal energy. The STES is a cascaded total energy system configuration. It uses parabolic disch collectors and a steam turbine-generator. The electrical system will be grid connected to the Georgia Power Company system. S.F.

N81-30548*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL ISOLATED APPLICATION EXPERIMENT SERIES
Richard R. Levin *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 209-213

Avail: NTIS HC A13/MF A01 CSCL 10A

The technical, operational, and economic readiness of parabolic dish power systems for a variety of applications in the power range below 10 MWe are discussed. Power systems are developed and tested to the point where commercialization efforts lead to successful market penetration. A key element in this strategy is the use of experiments to test hardware and assess operational readiness. The Isolated Application Experiments are described and their objectives discussed. S.F.

N81-30549*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INDUSTRIAL APPLICATION EXPERIMENT SERIES
Steven A. Bluhm *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 215-216

Avail: NTIS HC A13/MF A01 CSCL 10B

Two procurements within the Industrial Application Experiment Series of the Thermal Power Systems Project are discussed. The first procurement, initiated in April 1980, resulted in an award to the Applied Concepts Corporation for the Capital Concrete Experiment: two Fresnel concentrating collectors will be evaluated in single-unit installations at the Jet Propulsion Laboratory Parabolic Dish Test Site and at Capitol Concrete Products, Topeka, Kansas. The second procurement, initiated in March 1981, is titled, 'Thermal System Engineering Experiment B.' The objective of the procurement is the rapid deployment of developed parabolic dish collectors. S.F.

N81-30650*# Applied Concepts Corp., Reston, Va.
A FRESNEL COLLECTOR PROCESS HEAT EXPERIMENT AT CAPITOL CONCRETE PRODUCTS
J. Scott Hauger *In* JPL Parabolic Dish Solar Thermal Poweer Ann. Program Rev. Proc. 1 May 1981 p 217-221

Avail: NTIS HC A13/MF A01 CSCL 10B

An experiment is planned, conducted and evaluated to determine the feasibility of using a Power Kinetics' Fresnel concentrator to provide process heat in an industrial environment. The plant provides process steam at 50 to 60 psig to two autoclaves for curing masonry blocks. When steam is not required, the plant preheats hot water for later use. A second system is installed at the Jet Propulsion Laboratory parabolic dish test site for hardware validation and experiment control. Experiment design allows for the extrapolation of results to varying demands for steam and hot water, and includes a consideration of some socio-technical factors such as the impact on production scheduling of diurnal variations in energy availability. S.F.

N81-30652*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COST GOALS
John Hoag *In its* Parabolic Dish Solsr Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 247-250

Avail: NTIS HC A13/MF A01 CSCL 05C

Cost goal activities for the point focusing parabolic dish program are reported. Cost goals involve three tasks: (1) determination of the value of the dish systems to potential users; (2) the cost targets of the dish system are set out; (3) the value side and cost side are integrated to provide information concerning the potential size of the market for parabolic dishes. The latter two activities are emphasized. S.F.

N81-30653*# Science Applications, Inc., Golden, Colo.
AN ASSESSMENT OF THE INDUSTRIAL COGENERATION MARKET FOR PARABOLIC DISH SYSTEMS
J. W. Doane *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 251-253

Avail: NTIS HC A13/MF A01 CSCL 10B

The value analysis technique used is straightforward. Maximum allowable life-cycle system cost for the cogeneration system is determined as the sum of the present value of fuels displaced plus the present value of revenues from exported power. Each conventional fuel displaced is described by a unit cost in the first year, a uniform annual consumption rate, and a uniform annual escalation rate for unit cost. Exported energy flows are treated the same as displaced energy. S.F.

N81-30655*# IIT Research Inst., Chicago, Ill.
FUELS AND CHEMICALS FROM BIOMASS USING SOLAR THERMAL ENERGY
G. Giori, R. Leitheiser (Quaker Oats Co.), and M. Wayman (Toronto Univ.) *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 263-267 ref

Avail: NTIS HC A13/MF A01 CSCL 10A

The significant nearer term opportunities for the application of solar thermal energy to the manufacture of fuels and chemicals from biomass are summarized, with some comments on resource availability, market potential and economics. Consideration is given to the production of furfural from agricultural residues, and the role of furfural and its derivatives as a replacement for petrochemicals in the plastics industry. S.F.

N81-30656*# Midwest Research Inst., Golden, Colo.
SOLAR THERMAL MATERIALS RESEARCH AND DEVELOPMENT
B. P. Gupta *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 269-273

Avail: NTIS HC A13/MF A01 CSCL 10A

Objectives of the Materials Research and Development effort are examined. The behavior and interaction of different materials used in solar thermal technologies are studied so as to create a sound technical base for future system and component designs. Materials are developed to extend the application potential of systems by either making materials more reliable in difficult operating environments or by offering lower cost alternatives to presently used materials. Solar thermal systems designed for electric power, industrial process heat from low to high temperature, and fuels and chemicals applications are discussed. S.F.

N81-30657*# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR ENERGY WATER DESALINATION IN THE UNITED STATES AND SAUDI ARABIA
Werner Luft and Jim William *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 275-282

Avail: NTIS HC A13/MF A01 CSCL 10B

Five solar energy water desalination systems were designed to deliver 6000 cubic m/day of desalted water from either seawater or brackish water. Two systems will be selected for pilot plant construction. The pilot plants will have capacities in the range of 100 to 400 m/day. Goals of the Project Agreement for Cooperation in the Field of Solar Energy, under the auspices of the United States-Saudi Arabian Joint Commission on Economic Cooperation, are to: (1) cooperate in the field of solar energy technology for the mutual benefit of the two countries, including the development and stimulation of solar industries within the two countries; (2) advance the development of solar energy technology in the two countries; and (3) facilitate the transfer between the two countries of technology developed under this agreement. S.F.

N81-30664# Army Construction Engineering Research Lab., Champaign, Ill.
DEVELOPMENT OF AN ACCEPTANCE TEST FOR SOLAR ENERGY SYSTEMS Final Report
D. M. Joncich and D. L. Johnson Jun. 1981 83 p refs (AD-A101654; CERL-TR-E-173) Avail: NTIS HC A05/MF A01 CSCL 10/1

This report describes the development and field evaluation of a short-duration procedure and an instrumentation package for testing whether a newly installed solar energy system is performing to design specifications. The U.S. Army Construction Engineering Research Laboratory: (1) defined a general solar system schematic and identified its major components; (2) developed test procedures for determining the thermal performance of these components; (3) bought and programmed equipment to perform the prescribed component test and to produce the test data; (4) subjected the acceptance test concept and instrumentation package to a field evaluation at a newly installed Army solar energy system; and (5) incorporated the results of the field evaluation as modifications to the solar acceptance test. This report concludes that a simple, quantitative test of short duration can determine whether a newly installed solar system is operating as specified. The results of the research have revealed the potential for performing such a test with low-cost metering installed at the time of building construction.
Author (GRA)

N81-30665# Hughes Aircraft Co., Los Angeles, Calif. Space and Communications Group.
HIGH EFFICIENCY SOLAR PANEL. PHASE 2: GALLIUM ARSENIDE Final Report, 15 Sep. 1977 - 30 Sep. 1980
George Wolff, Sanjiv S. Kamath, and George J. Vendura Wright-Patterson AFB, Ohio AFWAL Mar. 1981 127 p refs (Contract F33615-77-C-3150; AF Proj. 682J) (AD-A101317; HAC-SCG-00453R; AFWAL-TR-80-2128) Avail: NTIS HC A07/MF A01 CSCL 10/2

The goals of the GaAs High Efficiency Solar Panel Program were to demonstrate experimentally that space cells with efficiencies of 16% or better can be consistently produced. In developing the cells, fabrication processes were to be streamlined and perfected so cells are readily producible in large quantities. All the goals of the program were met in that the process for growing cells with efficiencies greater than 18% was fully

developed. Cells with efficiencies greater than 18% were produced. A comprehensive qualification test program was successfully conducted, and the GaAs cells are now fully space qualified.
Author (GRA)

N81-30686# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
TECHNICAL AND ECONOMIC EVALUATION OF A BRAYTON-RANKINE COMBINED CYCLE SOLAR-THERMAL POWER PLANT
J. D. Wright and Richard J. Copeland May 1981 6 p refs Presented at Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26-30 May 1981 Submitted for publication
(Contract DE-AC02-77CH-00178)
(SERI/TP-631-1154; CONF-810509-36) Avail: NTIS HC A02/MF A01

An assessment of gas-liquid direct-contact heat exchange and of a new storage-coupled system was conducted. Both technical and economic issues are evaluated. Specifically, the storage-coupled combined cycle is compared with a molten salt system. The open Brayton cycle system is used as a topping cycle, and the reject heat powers the molten salt/Rankine system. In this study the molten salt system is left unmodified, the Brayton cycle is integrated on top of a Marietta description of an existing molten salt plant. This compares a nonoptimized combined cycle with an optimized molten salt system. DOE

N81-30687# Midwest Research Inst., Golden, Colo.
OPTIMIZING THE PERFORMANCE OF DESICCANT BEDS FOR SOLAR-REGENERATED COOLING
R. Barlow and K. Collier Mar. 1981 5 p refs Presented at Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC02-77CH-00178)
(SERI/TP-631-1157; CONF-810509-28) Avail: NTIS HC A02/MF A01

The use of computer simulations as well as a simplified psychrometric analysis to determine the increase in cooling system performance that can be realized through the use of nonhomogeneous or staged desiccant beds was investigated. A staged bed of four hypothetical desiccants gives a 10% higher cooling capacity than a silica gel bed of the same thickness. Alternatively, the same cooling capacity is produced by a staged bed 37% thinner than the silica gel bed. It is suggested that these effects can be employed to reduce the parasitic power requirements of desiccant cooling systems. DOE

N81-30688# Midwest Research Inst., Golden, Colo.
MIS AND PN JUNCTION SOLAR CELLS ON THIN FILM POLYCRYSTALLINE SILICON
A. Ariotedjo, K. Emery, G. Cheek, P. Pierce, and T. Surek May 1981 5 p refs Presented at 15th IEEE PV Specialists Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC02-77CH-00178)
(SERI/TP-614-1214; CONF-810526-9) Avail: NTIS HC A02/MF A01

The potential of MIS type solar cells for low cost terrestrial photovoltaic systems were assessed. Performance, stability, and cost effectiveness were among the factors studied. Several types of MIS and SIS solar cells are included in the matrix study. The MIS and p/n junction solar cells are compared on essentially identical thin film polycrystalline silicon materials. Preliminary data on the different cell structures on thin film epitaxial silicon on metallurgical grade substrates are presented. DOE

N81-30689# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
MIS SILICON SOLAR CELLS: POTENTIAL ADVANTAGES
G. Cheek, R. Mertens (ESAT, Heverlee, Belgium), and K. U. Leuven (ESAT, Heverlee, Belgium) May 1981 6 p refs Presented at 15th IEEE PV Specialists Conf., Orlando, Fla.
(Contracts EG-77-C-01-4042; DE-AC02-77CH-00178)
(SERI/TP-612-1190; CONF-810526-10) Avail: NTIS HC A02/MF A01

Recent progress with silicon solar cells based on the MIS or SIS structure was reviewed. To be competitive with pn junction technology in the near term, these cells must be much cheaper or have a higher efficiency in a production environment. Apparently, the minority carrier MIS cells have the greatest potential for large scale applications. The data currently indicate that all types of MIS/SIS cells have some inherent instability problems. DOE

N81-30673# HITEK, Inc., Sweet Home, Oreg.
KEITH KEESECKER OFFICE BUILDING Final Technical Report
Charles L. Bliege 28 Jan. 1981 52 p
(Contracts DE-FC05-78CS-32144; EM-78-F-03-2144)
(DOE/CS-32144/T1) Avail: NTIS HC A04/MF A01

The solar collection system of an office building in oregon is described. This two story office building has 4000 sq ft of space and a sq ft basement. The solar heating system has 936 sq ft of flat plate collectors and a phase change storage system. A description of the system operation, the acceptance test plan, as built wiring and piping schematics, and predicted performance data are included. DOE

N81-30674# Sandia Labs., Albuquerque, N. Mex. Systems and Applications Development Div.
CLEANING STRATEGIES FOR PARABOLIC-TROUGH SOLAR-COLLECTOR FIELDS; GUIDELINES FOR DECISIONS
Kenneth D. Bergeron and James M. Freese Jun. 1981 54 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0385) Avail: NTIS HC A04/MF A01

The guidelines are based on information obtained in past research studies, as well as interviews with vendors and users of cleaning and water treatment equipment. The basic procedure recommended utilizes high pressure portable washing equipment. However, since the cleaning problem is so site-specific, no single, detailed approach can be specified. A systematic procedure for evaluating the particular requirements of a site is therefore given. This will allow the solar energy system operator to develop a cleaning strategy which is cost effective because it is suited to local conditions. DOE

N81-30675# Sandia Labs., Albuquerque, N. Mex. Systems and Applications Development Div.
INITIAL EXPERIENCE AND PRELIMINARY RESULTS: SOLAR COLLECTOR MATERIALS EXPOSURE TO THE IPH SITE ENVIRONMENT
Duane E. Randall and Virgina L. Morris Mar. 1981 192 p refs Prepared in cooperation with McDonnell-Douglas Astronautics, Co., Huntington Beech, Calif.
(Contract DE-AC04-76DP-00789)
(SAND-81-0290) Avail: NTIS HC A09/MF A01

The influence of the industrial plant site environment upon the performance characteristics of solar collector reflector and receiver materials was evaluated at industrial process heat solar project sites. The program demonstrates that the industrial environment offers a variety of sources that affect the optical characteristics of reflectors and receivers through the mechanisms of soiling and corrosion. DOE

N81-30676# Sandia Labs., Albuquerque, N. Mex. Solar Energy Projects.
REAL-TIME PERFORMANCE TESTING OF PHOTOVOLTAIC-CONCENTRATOR MODULES
D. A. Pritchard 1981 5 p refs Presented at the 15th IEEE PV Specialists' Conf., 11 May 1981, Orlando, Fla.
(Contract DE-AC04-76DP-00789)
(SAND-81-1145C; CONF-810526-11) Avail: NTIS HC A02/MF A01

A description of the resources at the Photovoltaic Advanced Systems Test Facility is presented. These resources include a multi-level data acquisition system for collector module performance testing, associated user-interactive software for accomplishing these tests, and extensive support hardware. A group of standard tests was developed for module characterization. Descriptions of these tests and sample results for a variety of module designs are presented. DOE

N81-30678# Sandia Labs., Albuquerque, N. Mex.
PHOTOVOLTAIC CONCENTRATOR TECHNOLOGY
E. C. Boes and B. D. Shafer 1981 6 p refs Presented at the 15th IEEE PV Spec. Conf., 11 May 1981, Orlando, Fla.
(Contract DE-AC04-76DP-00789)
(SAND-81-1211C; CONF-810526-21) Avail: NTIS HC A02/MF A01

The most significant of the recent advances in the development of concentrating photovoltaic collectors are described. Highlights are: in moderate volume production (100,000 sq m per year), current designs could be sold for $3.70 to $5.20 per annualized

peak watt, completely installed; several array designs have annual efficiencies of 10 to 13 percent, developmental have achieved 16 percent; and concentrator Si cells were tested above 20 percent at 27 C and 50X. DOE

N81-30578# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RESIDENTIAL PHOTOVOLTAIC POWER SYSTEMS FOR THE NORTHEAST
Miles C. Russell 1981 5 p Presented at the 15th IEEE Photovoltaic Specialists' Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/132; CONF-810526-24) Avail: NTIS HC A02/MF A01

The construction and testing of five Prototype Systems are reported. Each of these systems utilizes a roof-mounted photovoltaic array and allows excess solar-generated electric energy to be fed back to the local utility grid, eliminating the need for on-site storage. Specific features of the five Prototype Systems now under test are presented, and performance results to date are discussed. DOE

N81-30580# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RESIDENTIAL PHOTOVOLTAIC SYSTEM DESIGNS
M. C. Russell 1981 5 p refs Presented at the 15th IEEE PV Specialists' Conf., Orlando, Fla., 11 May 1981 and 16th Intersoc. Energy Conversion Eng. Conf., Atlanta, 9-14 Aug 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/123; CONF-810526-17) Avail: NTIS HC A02/MF A01

The construction and testing of five Prototype Systems are described. All systems utilize a roof-mounted photovoltaic array and allow excess solar-generated electric energy to be fed back to the local utility grid, eliminating the need for on-site storage. Residential photovoltaic system design issues are discussed an specific features of the five Prototype Systems are presented. DOE

N81-30581# Sandia Labs., Albuquerque, N. Mex.
INTERDIGITATED BACK CONTACT SOLAR CELL WITH HIGH-CURRENT COLLECTION
C. M. Garner, R. D. Nasby, F. W. Sexton, J. L. Rodriguez, and D. P. Norwood 1981 8 p refs Presented at the 15th IEEE PV Specialists' Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2206C; CONF-810526-13) Avail: NTIS HC A02/MF A01

Internal current collection efficiencies greater than 90% and energy conversion efficiencies of 18 % at 30 suns were measured on a laboratory version of the interdigitated back contact (IBC) solar cell. A phosphorous gettering diffusion was performed on the front surface and then etched off to achieve these high current collection efficiencies. Thermal oxides were grown on the front and back of the cell to passivate the silicon surfaces. Although the internal collection efficiencies of the cell were high, series resistance caused the fill factor (FF) to decrease at concentrations above 30 suns. Dark current measurements on cells with a new grid spacing indicate that the series resistance is much lower than in the previous cell design. It is suggested that this should result in higher efficiencies at high concentration. DOE

N81-30582# Sandia Labs., Livermore, Calif. Surface Metallurgy Div.
DEVELOPMENT OF SOLAR ENERGY IN PERU
Hugh O. Pierson and Alipio Nahui (ITINTEC, Lima, Peru) Jun. 1981 24 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0764) Avail: NTIS HC A02/MF A01

Development of solar energy technology utilization in Peru is discussed. Peru receives a high degree of solar radiation (except for part of its coastal area) and has almost an ideal climate for the development of solar energy. The development of low temperature applications, including the design of passive solar heated buildings for the high Andes, the design and evaluation of various types of solar water heaters and crop dryers for both household and industrial uses (based on flat plate collectors), and the construction of a desalinization prototype plant are reported. Photovoltaic systems are investigated for suitable applications and have an excellent potential, especially in telecommunications. DOE

N81-30591# Little (Arthur D.), Inc., Cambridge, Mass.
SOLAR HEATING AND COOLING (SHAC) SIMULATION PROGRAMS: ASSESSMENT AND EVALUATION. VOLUME 1: SUMMARY REPORT Final Report
Richard L. Merriam May 1981 26 p refs
(EPRI Proj. 1269-1)
(EPRI-EM-1866) Avail: NTIS HC A03/MF A01

Solar heating and cooling system simulation programs available to use by electric utilities was evaluated. A comprehensive reference manual describing the characteristics of computer programs and manual methods was developed. An analysis of the intended capabilities of 11 programs is carried out. The programs are described and ranked by application. Four programs (AXCESS, DEROB, EMPSS, TRNSYS) for three building types (residential, light commercial, and heavy commercial) and three heating and cooling system classes (conventional, active solar, passive solar are tested. The results are compared and related to the program analytical bases. The user experience encountered during the program testing is highlighted and the user related factors for the four programs are compared. The applicability of the 11 programs to utilities is explored DOE

N81-30593# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
FACILITIES DEVELOPMENT, SAN DIEGO, CALIFORNIA SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION, JANUARY 1980 - DECEMBER 1980
K. D. Evans 1980 82 p refs
(Contract DE-AC01-79CS-30027)
(SOLAR/1017-80/14) Avail: NTIS HC A05/MF A01

A 31-unit apartment site which uses 520 square of flat-plate collectors for domestic water heating is discussed. A 1,000 gallon glass-lined storage tank is located underground. The overall solar fraction is 35 percent. Problems are discussed. DOE

N81-30594# Institute for Telecommunication Sciences, Boulder, Colo.
ALTERNATE FREQUENCY ANALYSIS FOR THE SOLAR POWER SYSTEM
E. L. Morrison and W. B. Grant 1981 147 p refs
(Contract DE-AI01-80ER-10160)
(DOE/ER-10160/T5) Avail: NTIS HC A03/MF A01

Frequencies below the proposed 2.45 GHz are not recommended because of increased compatibility problems with a large population of existing systems and target spacebeams and rectenna areas. Higher frequencies increase troposphere interactions which significantly reduce system efficiency during storm conditions. The increased media modulation effects at higher frequencies complicate the spacetenna control functions, including the stability of the main beam aim point and side lobe amplitude control loops. DOE

N81-30606# General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
LOW-COST ACTIVELY-COOLED LINEAR PHOTOVOLTAIC RECEIVER
N. F. Shepard, Jr. 1981 20 p refs Presented at the 15th IEEE Photovoltaic Specialists Conf., Orlando, Fla., 11-15 May 1981 Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(SAND-81-7113C; CONF-810526-14) Avail: NTIS HC A02/MF A01

The design concept, which employs a pair of nested glass tubes, offers the potential for low-cost production through reduced material content and design simplicity. A specially configured borosilicate glass tube functions as the mounting surface for the solar cell circuit in this dual focus receiver geometry. This inner tube, which is capped at each end to provide an interior dead air space, is inserted within a 2 inch ID glass pipe which is part of the Corning Pyrex beaded pressure process piping system. The selected receiver coolant, which is designated as Synfluid (2 centistokes kinematic viscosity), is circulated through the outer glass pipe in direct contact with the solar cell circuit active area. The concentrated irradiance from the parabolic trough impinges on the outer glass pipe and is optically transmitted through the clear synthetic mineral oil to the solar cell circuit. DOE

N81-30608# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LIQUID PHOTOVOLTAIC/THERMAL COLLECTORS FOR RESIDENTIAL APPLICATIONS

Susan D. Hendrie, Pattabiraman Raghuraman, and Charles Cox 1981 4 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/137; CONF-810526-22) Avail: NTIS HC A02/MF A01

The fabrication of a second generation, liquid photovoltaic/thermal collector is described. Results of computer simulations indicate that the collector unit, which incorporates novel cell and framing concepts, yields significnatly improved performance results over earlier units tested. Predicted performance values of 55% thermal efficiency and 11% electrical efficiency make the performance and this collector competitive with its single function solar thermal and photovoltaic counterparts. DOE

N81-30609# Lincoln Lab., Mass. Inst. of Tech., Lexington.
OPERATING EXPERIENCE WITH THE NATURAL BRIDGES NATIONAL MONUMENT PHOTOVOLTAIC POWER SYSTEM
F. John Solman and Barbara L. Grossman 1981 6 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/135; CONF-810526-15) Avail: NTIS HC A02/MF A01

A 100-kW photovoltaic power system was constructed and made operational. A comparison of system simulation with actual operation was performed and good agreement was found. Conservation measures and their benefits are described. Operating experience with the system is presented, including measured component performance of the arrays, batteries, inverters, and system overhead loads. DOE

N81-30616# Sandia Labs., Albuquerque, N. Mex.
ARRAY SUBSYSTEM DEVELOPMENT FOR PHOTOVOLTAIC-ARRAY FIELDS
H. N. Post and D. G. Schueler 1981 7 p refs Presented at the 15th IEEE Photovoltaic Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1193C; CONF-810526-20) Avail: NTIS HC A02/MF A01

The array subsystems portion of a photovoltaic power system represents the major cost item in a system and typically includes the photovoltaic modules, array foundations and structures, field wiring, array installation, and system electrical protection. Array cost-efficiency tradeoffs were examined and evaluated in terms of allowable subsystem costs. In addition, cost data and installation experience for a typical intermediate-size flat panel (ground mounted) application experiment are examined with a focus on cost reduction activities. Subsystem requirements and design considerations are discussed and specific results and guidelines for low-cost array field design are presented. DOE

N81-30617# Sandia Labs., Albuquerque, N. Mex.
OVERVIEW: RECENT DEVELOPMENTS AND POTENTIAL OF PHOTOVOLTAIC CONCENTRATING COLLECTORS
D. G. Schueler 1981 5 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1222C; CONF-810526-19) Avail: NTIS HC A02/MF A01

Definition and development of technology for low cost photovoltaic concentrating collectors are discussed. The most promising candidate approaches are point focus an linear-focus Fresnel lens designs using silicon solar cell technology and two axis tracking. Incremental improvements in these base line designs are expected to lead to cost effective photovoltaic collector subsystems. Recent developments in photovoltaic concentrator technology with respect to its long range economic potential are reviewed. DOE

N81-30629# Oak Ridge National Lab., Tenn. Solar and Special Studies Section.
EXPERIENCE FROM DOE PHOTOVOLTAIC GRANT PROJECTS
S. I. Kaplan 1981 8 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26-30 May 1981
(Contract W-7405-eng-26)
(CONF-810609-38) Avail: NTIS HC A02/MF A01

Two large solar photovoltaic (PV) energy systems are scheduled for operation. Although both are located at 2 year colleges in the south central U.S. and are of roughly comparable output capability, their configuration and operating objectives differ considerably. The systems are described and significant items of experience during their design, construction, testing and operation are chronicled. DOE

N81-30632# Massachusetts Inst. of Tech., Cambridge.
RETROFITTING RESIDENCES WITH PHOTOVOLTAIC/THERMAL COLLECTOR SYSTEMS
Duncan B. Sheldon and Susan M. Frank 1981 5 p refs Presented at the 16th Intersoc. Energy Conversion Eng. Conf., Atlanta, 9-14 Aug. 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/131; CONF-810812-5) Avail: NTIS HC A02/MF A01

Photovoltaic/thermal collector areas as low as 10 sq m are favorably matched to the operation of a conventional warm air heating system. The performances of three combined collector heating systems which are designed to operate primarily in the boosting mode were simulated. Comparison of the annual performances of these systems determines which components should be included in a retrofit system. Additional components such as a thermal storage tank and a heat pump are considered. DOE

N81-30634# Sandia Labs., Albuquerque, N. Mex.
PHOTOVOLTAIC-SYSTEM DEVELOPMENT STATUS
Gary J. Jones 1981 5 p refs Presented at the Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC04-76DP-00789)
(CONF-810509-37) Avail: NTIS HC A02/MF A01

Existent price and performance goals for photovoltaic applications are discussed. Specific attention is given to efforts to reduce present costs, especially for the nonphotovoltaic system elements such as power processing, field installation, and systems engineering. The impact of the efficiency of dc to ac conversion is also discussed. E.A.K.

N81-30641# Sandia Labs., Albuquerque, N. Mex.
DESIGN OF PHOTOVOLTAIC SYSTEMS FOR RESIDENTIAL APPLICATIONS
Gary J. Jones 1981 6 p refs Presented at the 15th IEEE PV Specialists Conf., Orlando, Fla., 11 May 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1241C; CONF-810526-29) Avail: NTIS HC A02/MF A01

Advantages and limitations of the potential residential photovoltaic system market and the impact of recent studies on future designs are reviewed. Typical system configurations are projected based on the existence of ideal rate structures and utility interactive operation. Sizing tradeoffs are analyzed in detail showing that systems from 3 kW/sub p/ to 10 kW/sub p/ are probable. Based on load considerations, development of 4 kW/sub p/ and 8 kW/sub p/ systems is suggested. The impact of this choice on array sizing as a function of site is discussed. DOE

N81-30649# State Univ. of New York at Albany. Atmospheric Sciences Research Center.
SOLAR DEMONSTRATION PROJECT IN A FAST-FOOD RESTAURANT
Donald McClenahen Nov. 1980 130 p refs Sponsored by New York State Energy Research and Development Authority
(PB81-196545; NYERDA-80-20) Avail: NTIS HC A07/MF A01 CSCL 13A

The results of a two-phase program in which the first phase included the successful use of heat reclamation equipment and energy conservation techniques at a typical fast-food restaurant are described. The project's second phase involved the engineering, designing, installation and interfacing of a solar collector system at the facility. The report will help to serve as a guide for other restaurants around the state, and possibly the nation, which wish to install energy saving systems, or adopt energy-saving techniques, geared to their special needs and equipment. GRA

N81-30653# Virginia Polytechnic Inst. and State Univ., Blacksburg.
EFFECTS OF TEST FLUID COMPOSITION AND FLOW RATES ON THE THERMAL EFFICIENCY OF SOLAR COLLECTORS Final Report

William C. Thomas Aug. 1980 93 p refs Sponsored in part by NBS and DOE
(PB81-180267; NBS-GCR-80-254; VPI-SU-80-03) Avail: NTIS HC A05/MF A01 CSCL 13A

Experimental and analytical investigations were carried out to determine the significance of the heat transfer fluid and mass flow rate on the thermal performance of two liquid heating flat plate solar collectors. The collector thermal performance was lowered significantly for high concentrations of glycol and mineral base oil. GRA

N81-30655# Design Alternatives, Inc., Washington, D. C.
PLANNING LOCAL SOLAR PROJECTS
1981 65 p
(Contract CSA-09AF-009)
(PB81-197014) Avail: NTIS HC A04/MF A01 CSCL 13A

A handbook which is used as an aid in local solar project development is presented. The purpose of this guidebook is to serve as a guide in the development, implementation, and evaluation of a local solar project. GRA

N81-31626*# Portsmouth Public Schools, Va.
SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT JAMES HURST ELEMENTARY SCHOOL, PORTSMOUTH, VIRGINIA Final Report
Jul. 1981 166 p Sponsored in part by NASA. Marshall Space Flight Center
(Contract EM-78-F01-5205)
(NASA-CR-161830) Avail: NTIS HC A08/MF A01 CSCL 10B

Solar heating and a hot water system installed in an elementary school in Portsmouth, Virginia are examined. The building is zoned into four heating/cooling areas. Each area is equipped with an air handling unit that is monitored and controlled by central control and monitoring system. The solar system for the building uses a collector area of 3,630 sq. ft. of flat plate liquid collectors, and a 6,000 gallon storage tank. System descriptions, maintenance reports, detailed component specifications, and design drawings to evaluate this solar system are reported. E.A.K.

N81-31653# Ehrenkrantz Group, New York, N. Y.
IDENTIFICATION OF PRODUCT AND MATERIAL DIFFERENCES IN ACTIVE SOLAR SYSTEMS
Stephen D. Weinstein 30 Sep. 1980 81 p Prepared in cooperation with Mueller Associates, Inc.
(Contract W-31-109-eng-38)
(ANL-K-81-74) Avail: NTIS HC A05/MF A01

Deficiencies in products and materials used in active solar systems are identified. Architects and engineers were interviewed concerning design of solar installations, computer modeling, reliability and durability, project review, and construction administration. The responses of manufacturers of solar equipment to the evaluations of the design community are presented. DOE

N81-31655# Stanford Univ., Calif.
SOLAR SPACE- AND WATER-HEATING SYSTEM AT STANFORD UNIVERSITY. CENTRAL FOOD SERVICES BUILDING Final Report
May 1980 143 p refs
(Contract DE-AB03-77CS-31522)
(DOE/CS-31522/T2) Avail: NTIS HC A07/MF A01

The closed-loop drain-back system is described as offering dependability of gravity drain-back freeze protection, low maintenance, minimal costs, and simplicity. The system features an 840 square-foot collector and storage capacity of 1550 gallons. The acceptance testing and the predicted system performance data are briefly described. Solar performance calculations were performed using a computer design program (FCHART). Bidding, costs, and economics of the system are reviewed. Problems are discussed and solutions and recommendations given. An operation and maintenance manual is given. DOE

N81-31657# Sandia Labs., Livermore, Calif.
SELECTION AND CONCEPTUAL DESIGN OF AN ADVANCED THERMAL-ENERGY-STORAGE SUBSYSTEM FOR COMMERCIAL-SCALE (100 MWe) SOLAR CENTRAL-RECEIVER POWER PLANT
Feb. 1981 201 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-8190; SAW-1662) Avail: NTIS HC A10/MF A01

Advanced thermal energy storage concepts were developed and evaluated which are applicable to a 100 MWe solar central receiver plant using water/steam as the working fluid. Three concepts were selected that offered potential for cost and performance improvements over the oil/rock concepts. From the three concepts selected, the moving bed thermal energy storage system using a free flowing refractory material as the heat transport and storage media was chosen. A conceptual design was developed, including estimates for cost and performance. DOE

N81-31658# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.
STORAGE IN RESIDENTIAL SOLAR TOTAL-ENERGY SYSTEMS
R. W. Leigh Dec. 1980 85 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51230) Avail: NTIS HC A05/MF A01

The potential role of energy storage devices in solar total energy systems operating in a stand alone mode is examined. High temperature thermal storage is examined in the context of systems employing parabolic trough collectors and Rankine cycle conversion while batteries are evaluated in systems based on parabolic dish concentrators with Stirling cycle conversion or on nonconcentrating photovoltaic systems. In all three systems, storage was found to be advantageous in cases involving high future fuel prices and collectors meeting current cost goals, while storage was not found to be viable at fuel prices remaining near current levels and collector costs exceeding current expectations by substantial margins. Factors making storage more or less desirable are discussed. Throughout, analyses based on minimum cost (optimal) systems are employed. DOE

N81-31659# Ueland and Junker, Architects and Planners, Philadelphia, Pa.
SOLAR ATRIUM: A HYBRID SOLAR HEATING AND COOLING SYSTEM
Donald L. Larson May 1981 26 p Prepared in cooperation with Drexel Univ.
(Contracts DE-FG02-77CS-34135; EG-77-G-04-4135)
(DOE/CS-34135/T4) Avail: NTIS HC A03/MF A01

Solar atrium is a hybrid system of solar heating and cooling consisting of a central atrium space having a south wall aperture with movable insulating/shading louvers and a rock thermal storage unit in the basement. In addition, the atrium contains an open pool which serves as thermal mass and a source of humidity. Back up space heating and cooling is furnished by an air to air heat pump. Hot air is collected from the atrium ceiling and circulated by a fan through the rock bed and into the house duct system. A demonstration house in Philadelphia, Pennsylvania was designed, constructed, and monitored to test the concept. DOE

N81-31663# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SECOND-GENERATION HELIOSTAT DETAIL DESIGN REPORT
R. K. Knowles Aug. 1980 204 p
(Contract DE-AC04-76DP-00789)
(SAND-78-8192; MDC-G8631) Avail: NTIS HC A10/MF A01

The second generation heliostat design and a summary of the compliance of the design to the key heliostat requirements are reviewed. The heliostat hardware is described. The hardware and software design used to fulfill the requirements and the analysis and test used to evaluate related performance are presented. The technical feasibility and potential cost savings of a variety of automated mirror inspection techniques are assessed. DOE

N81-31665# Sandia Labs., Albuquerque, N. Mex.
COMMERCIALIZATION OF A PHOTOVOLTAIC CONCENTRATOR: ACUREX REPORT Final Report
J. Kull, G. Litzinger, B. Masters, and K. Yasuda Jul. 1981 167 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7082; FR-80-11/AE) Avail: NTIS HC A08/MF A01

A development program is described that has produced a new photovoltaic (PV) concentrator and concentrator manufactur-

ing facility. The new PV concentrator features active cooling and thermal energy recovery. Background information, a program description, key results, and recommendations for future work are provided. The concentrator design, operating experience, and production capability are described. The optical, electrical and mechanical considerations were addressed by evaluating various possible alternatives in engineering trade studies. Two receiver configurations selected based on study results are described. The performance of the new concentrator array was examined in a preliminary series of tests. DOE

N81-31668# Boeing Co., Seattle, Wash. Solar Heating and Cooling Demonstration Program Office.
WAVERLY HOMES, INC. (LOT 13) SINGLE FAMILY RESIDENCE, WESTMINSTER, COLORADO. SOLAR PROJECT DESCRIPTION
26 Mar. 1981 50 p
(Contract DE-AB01-76OS-31020)
(SOLAR/1022-81/50) Avail: NTIS HC A03/MF A01

The use of solar energy for space heating a single family home and preheating incoming city water is discussed. The system has an array of flat plate collectors with a gross area of 351 square feet. Air is used to deliver solar energy from the collector array to storage and to the space heating and hot water loads. Solar energy is stored in the basement in a 175 cubic foot concrete tin containing 17,500 pounds of rock. Solar energy preheated city water is stored in an 80 gallon preheat storage tank and supplied, to a conventional 40 gallon domestic hot water (DHW) tank. When solar energy is insufficient to satisfy the space heating load, a gas furnace provides auxiliary energy for space heating. Similarly, a gas heater in the DHW tank provides auxiliary energy for water heating. DOE

N81-31669# Science Applications, Inc., La Jolla, Calif.
COMPARISON OF CONVENTIONAL AND AND SOLAR-WATER-HEATING PRODUCTS AND INDUSTRIES REPORT
Darryl Noreen, Robert Lechevalier, Michael Choi, and Jeff Morehouse 11 Jul. 1980 299 p refs
(Contract DE-AC03-80CS-30217)
(DOE/CS-30217/T1) Avail: NTIS HC A13/MF A01

Issues are examined in the framework of the conventional-hot-water industry. Based on the results of this solar hot water assessment study, documented proof is presented to show that the solar industry possesses over 20 good solar hot water systems. A total of eight generic types are currently being produced, but a majority of the systems being sold are included in only five generic types. The good systems are well-packaged for quality, performance and installation ease. These leading systems are sized and designed to fit the requirements of the consumer in every respect. DOE

N81-31670# Sandia Labs., Livermore, Calif. Large Power Systems Div.
SOLAR POWER TOWER DESIGN GUIDE: SOLAR THERMAL CENTRAL RECEIVER POWER SYSTEMS. A SOURCE OF ELECTRICITY AND/OR PROCESS HEAT
Kirk W. Battleson Apr. 1981 162 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-8005) Avail: NTIS HC A08/MF A01

Preliminary evaluations of whether a solar thermal central receiver plant is technically and economically feasible and desirable, for the potential user's application are reported. The cost elements, performance, and operation of solar central receiver systems are described. DOE

N81-31673# Ingenieurbuero, Brushi (West Germany).
SOLAR ENERGY MODEL GOENNEBEK. DEVELOPMENT AND PLANNING OF A SELF-SUPPORTING HEATING PLANT FOR GREENHOUSES Final Report
Bernard Gerhards Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 133 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-119; ISSN-0340-7608) Avail: NTIS HC A07/MF A01

The recovery, storage, and saving of energy in greenhouses by application of solar energy is investigated. Self-sufficiency is sought by making use of long-term storage of summer heat. A pilot installation is described consisting of a greenhouse with air collector, a medium-term accumulator, a long-term water heat storage tank and a 1500 m square plane collector field. Detailed construction plans and data on energy requirements and costs are given. Full independence from fossil fuels of the greenhouse and adjacent auction hall and office space is demonstrated. Control and programming is performed by a process computer. The highly efficient heat insulation system is credited for most of the success. The present installation requires only 40% of the energy needs of a regular double glass greenhouse. Author (ESA)

N81-32279# Los Alamos Scientific Lab., N. Mex.
STATUS REPORT ON SOLAR-ABSORBER-PAINT COATINGS Progress Report
S. W. Moore Jul. 1981 22 p refs
(Contract W-7405-eng-36)
(LA-8897-SR) Avail: NTIS HC A02/MF A01

The stability and durability of solar absorber paint coatings were investigated. Changes in optical properties and physical failure of the coatings are described. The effects of elevated temperatures, moisture, humidity, ultraviolet radiation, outdoor stagnation, and outgassing were examined. The basic optical properties investigated were absorptance and emissivity. DOE

N81-32311# American Agriculture Foundation, Inc., Denver, Colo.
SOLAR ETHANOL DEMONSTRATION PLANT: REPORT OF PHASE 1, TECHNOLOGY ASSESSMENT AND PHASE 2, CONCEPT SELECTION
1 Jan. 1981 82 p refs
(Contract DE-AC07-80ID-12098)
(DE81-027187; DOE/ID-12098/T2) Avail: NTIS HC A05/MF A01

A versatile facility for demonstrating the feasibility of on-farm, small scale ethanol production using solar energy as the primary heat source is described. This facility is capable of processing the full range of feed stocks not only the sugar and starch crops but also the cellulose feedstocks. Engineering and cost analysis was performed to formulate a preliminary design for a unique solar ethanol demonstration plant for on-farm use. Energy requirements were calculated for a variety of starches, simple sugars, and cellulose. A complete listing of all feedstocks examined is presented. The design requirements and the detailed process plant design information with flow, layout and performance information are given along with the results of the ethanol feedstock energy requirements study. Supporting details of the solar collector selection process are included. The ethanol fermentation process, the range of cellulose-ethanol production processes, and a detailed description of the Solar Collector performance model are addressed. DOE

N81-32456# Brookhaven National Lab., Upton, N. Y. Solar Technology Group.
SOLAR ENERGY AND HEAT PUMPS: CAN THIS MARRIAGE BE SAVED
John W. Andrews 1981 10 p refs Presented at the IECEC Conf., Atlanta, 9-14 Aug. 1981
(Contract DE-AC02-76CH-00016)
(DE81-024371; BNL-29627; CONF-810812-26) Avail: NTIS HC A02/MF A01

Work on systems for building space and water heating and space cooling which combine vapor compression heat pumps with the use of solar energy led to promising system configurations which portend reasonable cost and beneficial impact on utility load profiles in addition to conserving energy. A historical perspective on this work are presented. The ranges of system possibilities are elucidated and two promising systems are described. DOE

N81-32457# Brookhaven National Lab., Upton, N. Y. Solar Technology Group.
TEST RESULTS OF PROTOTYPE SOLAR ASSISTED HEAT PUMPS
Mark A. Catan and Edward A. Kush 1981 8 p refs Presented at the IECEC Conf., Atlanta, 9-14 Aug. 1981
(Contract DE-AC02-76CH-00016)
(DE81-024372; BNL-29628; CONF-810812-23) Avail: NTIS HC A02/MF A01

Results of steady state tests of a prototype solar-assisted heat pump using a simulator are reported. The nominal goal for this project, construction of a prototype capable of achieving a heating coefficient of performance of 6 at an entering water temperature of 32 C (90 F), was achieved. Factors related to

reliability and potential for performance improvement of the design are treated. Plans for future testing and application of performance data to system studies are discussed. DOE

N81-32488# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
SOLAR-HEAT-PUMP SIMULATOR
Merk A. Caton 1981 7 p refs Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981
(Contract DE-AC02-76CH-00016)
(DE81-024370; BNL-29679; CONF-810672-24) Avail: NTIS HC A02/MF A01

A solar assisted heat pump (SAHP) hardware simulator was constructed to demonstrate the potential of the vapor compression heat pump to obtain high COP's at high source temperatures, to explore the means to obtain such high efficiencies, and to test prototype hardware resulting from the SAHF development program. The original water coolant system which simulated heating loads was upgraded to accommodate liquid to air heat pumps. A further refinement to the simulator was the addition of a on-line data acquisition and reduction facility. Testing of an experimental mockup heat pump designed to operate efficiently under SAHP system conditions demonstrated that very high COP's can be achieved with conventional components. One prototype marketable SAHP constructed by Northrop has been tested under steady state conditions using the simulator. DOE

N81-32489# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
TECHNICAL SUPPORT: SOLAR ASSISTED HEAT PUMP SYSTEMS
J. W. Andrews 1981 10 p refs Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981
(Contract DE-AC02-76CH-00016)
(DE81-102509; BNL-29681; CONF-810672-23) Avail: NTIS HC A02/MF A01

Technical and program planning provided in connection with the development of energy conserving and cost effective solar assisted heat pump systems is reviewed. The background of the program is outlined. DOE

N81-32507# Oak Ridge National Lab., Tenn. Solid State Div.
APPLICATION OF LASER ANNEALING AND LASER-INDUCED DIFFUSION TO PHOTOVOLTAIC CONVERSION
R. T. Young, D. H. Lowndes, G. A. vanderLeeden, and R. F. Wood 1981 22 p refs Presented at the Polycrystalline Silicon Subcontractors' Rev. Meeting, Alexandria, Va. 17-19 Jun. 1981
(Contract W-7405-eng-26)
(DE81-024125; CONF-810890-1) Avail: NTIS HC A02/MF A01

The electrical properties of individual grain boundaries were investigated and correlated with the mismatch of grain orientations. The effects of heat treatment on the grain boundaries were examined. The effects of lithium diffusion on polycrystalline Si solar cells were determined and (4) the calibration and operation of A Si-CVD system was calibrated and operated in the temperature range from 400 to 1100 C with SiH4 and SiH2Cl2 as the source gasses. DOE

N81-32604*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SATELLITE POWER SYSTEM CONCEPT DEVELOPMENT AND EVALUATION PROGRAM. VOLUME 2: SYSTEM DEFINITION
Jul. 1981 116 p refs
(NASA-TM-58236; JSC-17300) Avail: NTIS HC A06/MF A01 CSCL 10A

The system level results of the system definition studies performed by NASA as a part of the Department of Energy/NASA satellite power system concept development and evaluation program are summarized. System requirements and guidelines are discussed as well as the major elements that comprise the reference system and its design options. Alternative system approaches including different system sizes, solid state amplifier (microwave) concepts, and laser power transmission system cost summaries are reviewed. An overview of the system analysis and planning efforts is included. The overall study led to the conclusion that the reference satellite power system concept is a feasible baseload source of electrical power and, within the assumed guidelines, the minimum cost per kilowatt is achieved at the maximum output of 5 gigawatts to the utility grid. Major unresolved technical issues include maximum allowable microwave power density in the ionosphere and performance/mass characteristics of laser power transmission systems. A.R.H.

N81-32606*# Monegon Ltd., Gaithersburg, Md.
PHOTOVOLTAIC STAND-ALONE SYSTEMS: PRELIMINARY ENGINEERING DESIGN HANDBOOK Final Contractor Report
H. L. Macomber, John B. Ruzek, and Frederick A. Costello Aug. 1981 248 p refs Prepared in cooperation with Costello (Frederick A.), Inc. and Bird Engineering Research Associates, Inc.
(Contract DEN3-195; DE-AI01-79ET-20485)
(NASA-CR-165352; DOE/NASA/0195-1; M206) Avail: NTIS CSCL 10A

Component design and engineering information, including estimation and reduction strategies, PV array characteristics, and material on batteries, power handling equipment, and back up systems are presented. The data needed to begin the design process and preliminary system design considerations are discussed. These considerations include analysis of insolation and siting, system sizing, feasibility assessment and reliability engineering approaches. Information on system design procedures and applicable codes and standards is presented. Information on system installation, operation, maintenance issues, personnel and facility safety requirements and various means of calculating insolation, including computer software and statistical computations are emphasized. T.M.

N81-32608*# Wyle Labs., Inc., Huntsville, Ala.
INDOOR TEST FOR THE THERMAL PERFORMANCE EVALUATION OF THE DEC 8A LARGE MANIFOLD SUNMASTER EVACUATED TUBE (LIQUID) SOLAR COLLECTOR
Sep. 1981 33 p refs
(Contract DEN0-00006)
(NASA-CR-161845; WYLE-TR-531-49) Avail: NTIS HC A03/MF A01 CSCL 10A

The Sunmaster DEC 8A Large Manifold solar collector using simulated conditions was evaluated. The collector provided 17.17 square feet of gross collector area. Test conditions, test requirements, an analysis of results, and tables of test data are reported. E.A.K.

N81-32609*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOLAR DRIVEN LIQUID METAL MHD POWER GENERATOR Patent Application
Ja H. Lee (Vanderbuilt Univ.) and Frank Hohl, inventors (to NASA) Filed 15 May 1981 15 p
(NASA-Case-LAR-12495-1; US-Patent-Appl-SN-263830) Avail: NTIS HC A02/MF A01 CSCL 10A

A method for solar electric power generation in space is described. A solar energy collector focuses solar energy onto a solar oven which is attached to a mixer which in turn is attached to the channel of a MHD generator. Gas enters the oven and a liquid metal enters the mixer. The gas/liquid metal mixture is heated by the collected solar energy and moves through the MHD generator thereby generating electrical power. The mixture is then separated and recycled. NASA

N81-32610 Committee on the Judiciary (U. S. Senate).
DOE'S ROLE IN THE SOLAR ENERGY INDUSTRY, AND POSSIBLE ANTICOMPETITIVE TRENDS
Washington GPO 1981 107 p refs Hearing before the Subcomm. on Antitrust, Monopoly and Business Rights of the Comm. on the Judiciary, 96th Congr., 2nd Sess., 14 Nov. 1980 (GPO-73-785) Avail: Subcommittee on Antitrust, Monopoly, and Business Rights

The concerns of small business in the solar energy field are discussed. The acquisitions of small companies by larger energy-intense companies was reviewed. Possible Federal regulations for the solar energy industry are considered and the overall solar energy policy for the nation is addressed. T.M.

N81-32618# Naval Postgraduate School, Monterey, Calif. Dept. of Administrative Sciences.
A STUDY OF PASSIVE SOLAR SPACE HEATING TECHNIQUES APPLIED TO FAMILY HOUSING UNITS WITHIN THE CONTINENTAL UNITED STATES M.S. Thesis
William Frederic Carr, Jr. Mar. 1981 135 p refs
(AD-A102714; NPS-54-81-003) Avail: NTIS HC A07/MF A01 CSCL 13/1

Passive solar energy is presented as an alternative to conventional space heating for existing and future government family housing units. The extent of the current energy problem is presented together with the implications of the findings of the Workshop on Alternative Energy Strategies. These findings significantly influence the impending energy problems facing the Department of Defense. A technical analysis is made of five passive solar space-heating design alternatives in five climate zones within the continental United States to determine the potential savings in conventional heating fuel and dollars to the Department of Defense. In addition, major advantages and disadvantages of solar energy are presented. Recommendations for the utilization of passive solar energy in family housing units conclude the thesis. Author (GRA)

N81-32619# Illinois Central Coll., East Peoria.
ALTERNATE HOME ENERGY APPLICATION AND DEMONSTRATION: PROJECT AHEAD Final Report
1 May 1981 80 p
(Contract DE-FG02-79R5-10112; Proj. AHEAD)
(DOE/R5-10112/T1) Avail: NTIS HC A05/MF A01

Project AHEAD, (Alternate Home Energy Application and Demonstration), an energy efficient, moderate cost, solar assisted home was demonstrated. The structure has three types of passive solar concepts: a trombe wall; a greenhouse; and a direct gain area. Project activities and the facility are described. DOE

N81-32620# Plasma Physics Corp., Locust Valley, N. Y.
PLASMA-ASSISTED CVD OF FLUORINATED, HYDROGENATED AMORPHOUS SILICON Final Report
John H. Coleman, John P. Hammes, and Harold J. Wiesmann
1981 42 p refs
(Contract DE-AC02-77CH-00178)
(SERI/TR-8041-2-T2) Avail: NTIS HC A03/MF A01

Three novel large area alpha-Si:H solar cells were developed. The following configurations are presented: inverted NIP/SS cells with an improved red response; inverted alpha-Si:H/alpha-BiH heterojunction cells with high V/sub oc/; and NIP/metal cells with a CVD P layer grown pyrolytically from silane and diborane. Experiments used disilane as the deposition gas for the intrinsic layer in both NIP/SS and PIN/SS structures. Coatings of In2O3, were applied to NIP/SS cells to evaluate its potential as a conductive coating in practical amorphous silicon solar cells. DOE

N81-32624# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
PERFORMANCE OF EVACUATED TUBULAR SOLAR COLLECTORS IN A RESIDENTIAL HEATING AND COOLING SYSTEM Final Report, 1 Oct. 1978 - 30 Sep. 1979
W. S. Duff and G. O. G. Loef Mar. 1981 196 p refs
(Contracts DE-AS02-76CS-32577; EY-76-S-02-2577)
(COO-2577-20) Avail: NTIS HC A09/MF A01

Operation of CSU Solar House I during the heating season of 1978-1979 and during the 1979 cooling season is discussed. The systems comprised an experimental evacuated tubular solar collector, a nonfreezing aqueous collection medium, heat exchange to an insulated conventional vertical cylindrical storage tank and to a built up rectangular insulated storage tank, heating of circulating air by solar heated water and by electric auxiliary in an off peak heat storage unit, space cooling by lithium bromide absorption chiller, and service water heating by solar exchange and electric auxiliary. The system is compared with CSU Solar Houses I, II and III. The experimental collector provides solar heating and cooling with minimum operational problems. Improved performance, particularly for cooling, resulted from the use of a very well insulated heat storage tank. Day time electric auxiliary heating is avoided by use of off peak electric heat storage. DOE

N81-32627# Midwest Research Inst., Golden, Colo. Systems Development Branch.
APPLICATION OF SOLAR PONDS TO DISTRICT HEATING AND COOLING
Cecile M. Leboeuf Apr. 1981 41 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-731-1036) Avail: NTIS HC A03/MF A01

A preliminary investigation is reported of the feasibility of incorporating solar ponds into subdivisions to provide district heating, domestic hot water (DHW), and district cooling. Two locations were chosen for analysis: Fort Worth, Texas and Washington, D.C. Solar ponds were sized to meet space heating, cooling, and DHW loads in each location for differing community sizes. Parameters such as storage layer temperature, pond geometry, and storage depth vs surface area were varied to determine the most effective approach to solar pond utilization. A distribution system for the district heating system was designed, including sizing of heat exchangers, piping, and pumps. Cost estimates for the pond and distribution system were formulated by using data generated in pond sizing, as well as associated system costs (e.g., salt costs and distribution system costs). Finally, solar ponds were found to be competitive with residential flat plate collector systems, with delivered energy costs as low as $16.00/GJ. DOE

N81-32634# Midwest Research Inst., Golden, Colo.
INVESTIGATION OF SOLAR CELLS BASED ON Cu2O Quarterly Report, 1 Dec. 1980 - 28 Feb. 1981
Larry C. Olsen (Joint Center for Graduate Study, Richland, Wash.)
Apr. 1981 26 p
(Contract DE-AC02-77CH-00178)
(SERI/PR-9190-1-T2; QR-3) Avail: NTIS HC A03/MF A01

Efforts during this quarter concentrated on: studies of the effect of copper purity on Cu2O resistivity and cell performance; thermodynamic investigations of Ti/Cu2O Schottky barriers. Samples from two different rods of five-nines purity copper were submitted for spark source mass spectrographic analyses. Cu2O substrates grown from copper wafers cut from the two rods exhibited significantly different resistivities, one much high then the other. It was determined that the material which yields high resistivity material is characterized by relatively large levels of impurities. DOE

N81-32635# Johnson Controls, Inc., Milwaukee, Wis.
COMMERCIALIZATION OF A THICK-FILM SOLAR CELL Final Technical Report, 15 Sep. 1980 - 30 Apr. 1981
Guy D. McDonald 1981 81 p refs Prepared for Midwest Research Inst.
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-8104-2-T4) Avail: NTIS HC A05/MF A01

No technical problems were encountered in the preparation of screen printed cadmium sulfide layers. High conductivity (less than 5 ohm cm resistivities) adherent layers could be produced on 7059 glass, Nesatron and tin oxide coated glass. No macro pinholes were observed in thick films. Solar cells produced from screen printed CdS had a maximum open circuit voltage of 0.44 volt and a maximum observed short circuit current of 8 ma/cm(2) under AM 1 illumination. A maximum cell efficiency of 2.2% was obtained. This performance is not felt to be a limitation produced by the screen printing approach but to be a limitation produced by the screen printing approach but to be reflective of an unoptimized procedure for producing Cu2S on the CdS film and the lack of a suitable post thermal treatment technique. DOE

N81-32637# EIC, Inc., Newton, Mass.
THERMAL STORAGE STUDIES FOR SOLAR HEATING AND COOLING: APPLICATIONS USING CHEMICAL HEAT PUMPS Final Report, 15 Sep. 1978 - 15 Apr. 1980
P. O. D. Offenhartz Apr. 1981 134 p refs
(Contract DE-AC02-79CS-30248)
(DOE/CS-30248/T1) Avail: NTIS HC A07/MF A01

The simulation of chemical heat pumps and simulations (including heating, cooling, and domestic hot water) were performed for Washington, D.C. and Ft. Worth, Texas. Direct weekly comparisons of the H2SO4/H2O and CaCl2/CH3OH cycles were carried out. Projected performance of the NH4NO3/NH3 cycle was also investigated, and was identical to H2SO4/H2O. In all simulated cases, the solar collector is a fixed evacuated tube system. With standard residential loads, the chemical heat pumps performed well. Gas fired backup via the heat pump was quite effective in reducing fossil fuel consumption. Chemical heat pumps are designed to reject heat at relatively high

temperatures, however, they are also effective in providing domestic hot water. DOE

N81-32638# United Technologies Corp., South Windsor, Conn. Power Systems Div.
INVESTIGATION OF A FAMILY OF POWER CONDITIONERS INTEGRATED INTO THE UTILITY GRID
Steven A. Eckhouse Jun. 1981 84 p
(Contract DE-AC04-76DP-00789)
(SAND-81-7016; FCR-2820) Avail: NTIS HC A05/MF A01

The design of a power conditioner for residential size solar photovoltaic applications is described. The ac and dc interface requirements are discussed. The design includes a simplified schematic, mechanical layout, and functional description. Performance and efficiency projections, and cost and reliability estimates are given. DOE

N81-32640# Martin Marietta Corp., Denver, Colo.
SECOND-GENERATION HELIOSTAT DEVELOPMENT, VOLUME 2
Apr. 1981 200 p
(Contract DE-AC04-76DP-00789)
(SAND-81-8176-Vol-2; MCR-81-1713) Avail: NTIS HC A09/MF A01

The design, manufacture, testing and cost analysis of the second generation heliostat are described. The following topics are discussed: the drawing tree for the heliostat; structural data of the rack assembly; drive mechanism and mirror assemblies, tests and results; a trade study on the pedestal foundation design; cost analysis worksheets; study of an edge support mirror module; and a study of a single motor, differential brake heliostat drive mechanism. DOE

N81-32642# Sandia Labs., Livermore, Calif. Applied Mechanics Div.
NONLINEAR THERMAL AND STRUCTURAL ANALYSIS OF A BRAZED SOLAR-CENTRAL-RECEIVER PANEL
L. M. Napolitano, Jr. and M. P. Kenouff Jul. 1981 45 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-8017) Avail: NTIS HC A03/MF A01

The panel incorporates a new way of joining tubes - brazing to intermediate filler strips which can affect the panel's lifetime. To calculate the stresses and strains for the worst-case section of the experimental panel, A nonlinear elastic-plastic analysis was performed with the MARC finite element computer code, which takes the temperature dependence of the material properties into account. From the results, tube design lifetimes are predicted. The analysis shows that concerns for cracking and reduction in lifetime are warranted, but a more detailed fracture analysis is necessary to determine whether there is a stable-crack-growth problem. DOE

N81-32643# Sandia Labs., Livermore, Calif. Large Power Systems Div.
INTERNATIONAL ENERGY AGENCY SMALL SOLAR POWER SYSTEMS (SSPS) PROJECT REVIEW
A. F. Baker May 1981 65 p
(Contract DE-AC04-76DP-00789)
(SAND-81-8218) Avail: NTIS HC A04/MF A01

The building of the small solar system project by the International Energy Agency in America province in Spain is reviewed. Background on the project and a definition and technical description of the main subsystems for the central receiver system and distributed collector system which are included in the project are provided. The current status of the planning for the tests and operation phase of the project are discussed. DOE

N81-32645# Sandia Labs., Albuquerque, N. Mex.
CONCEPTUAL DESIGN AND SYSTEM ANALYSIS STUDY FOR A HYBRID SOLAR PHOTOVOLTAIC/SOLAR THERMAL ELECTRIC POWER SYSTEM. VOLUME 3: APPENDICES Final Report
Jul. 1981 169 p Prepared in cooperation with Spectrolab, Inc., Sylmar, Calif.
(Contract DE-AC04-76DP-000789)
(SAND-80-7014-3) Avail: NTIS HC A08/MF A01

Hybrid photovoltaic/solar thermal electric conversion systems were analyzed. Several types of hybrid systems, photovoltaic only systems, and solar thermal electric systems in terms of performance and cost were compared. The computer code used in the analyses and background information on heat engines, thermal efficiencies of photovoltaic thermal collectors, and optical considerations for central receiver plants is also described. DOE

N81-32648# Sandia Labs., Albuquerque, N. Mex.
STUDY OF POTENTIAL PHOTOVOLTAIC/THERMAL APPLICATIONS IN THE COMMERCIAL SECTOR Final Report
C. D. Parker Jul. 1981 153 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7175) Avail: NTIS HC A08/MF A01

Applications for photovoltaic thermal (PV/T) systems, a procedure for ranking applications in the service, commercial, and institutional (SCI) sectors by using the energy consumption data base (which tabulates energy use by sector, region, fuel type, and end use) was identified. Temperature requirements of end use, effects of temperature on efficiencies, cost of fuels replaced, and thermal and electrical loads are considered. The electrical load and the temperature requirement of the thermal load determine size of the array, which meets the requirements of the entire electrical load. The rankings indicate the PV/T arrays are more cost effective than PV only arrays for most commercial applications. Absorption cooling can usually be substituted for vapor compression cooling. The high school load profiles are used for a PV/T array application. It is shown that the PV/T array can be used advantageously. DOE

N81-32649# Argonne National Lab., Ill.
TECHNOLOGY ASSESSMENT OF SOLAR ENERGY SYSTEMS: LOCAL EMPLOYMENT IMPACTS OF THE TASE ENERGY SCENARIOS
K. K. Smeltzer Nov. 1980 37 p refs
(Contract W-31-109-eng-38)
(ANL/EES-TM-134) Avail: NTIS HC A03/MF A01

The local requirements and impacts of on-site employment by the energy facilities embodied in the high and low solar scenarios of the Technology Assessment of Solar Energy project are analyzed. After presenting an overview of the project and the scenarios are postulated, the general energy-related employment consequences of these scenarios are discussed and are identified. These sources include a wide variety of solar and conventional energy systems whose construction/installation and operation and maintenance employment requirements are summarized from a variety of sources. These employment data, along with the scenarios' projections of energy contributions by each technology type, are used to determine the technology-specific, on-site employment requirements of the scenarios. Finally the likely local social and economic impacts of these requirements are identified and discussed. DOE

N81-32651# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR LANDURA CORPORATION SINGLE-FAMILY RESIDENCE, STAYTON, OREGON
24 Jul. 1981 57 p
(Contracts DE-AB01-78CS-31020; HUD-H-2372)
(SOLAR/1069-81/50) Avail: NTIS HC A04/MF A01

The solar project in a single family residence in Stayton, Oregon is discussed. The side has approximately 1500 square feet of conditioned space. The solar energy system has an array of flat plate collectors with a grass area of 357 square feet. The roof beneath the collector array is designed as a reflector surface and increases the effective collector area to 1072 square feet. Water is used as the transfer medium. Solar energy is stored above ground in two 1250 gallon tanks. Supply water is preheated in a heat exchanger coil in storage tank 1 and supplied, on demand, to a conventional 65 gallon DHW tank. DOE

N81-32655# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PRELIMINARY OPERATIONAL RESULTS OF THE LOW TEMPERATURE-SOLAR INDUSTRIAL-PROCESS-HEAT FIELD TESTS
Charles F. Kutscher and Roger L. Davenport Jun. 1981 43 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-029129; SERI/TR-632-385R) Avail: NTIS HC A03/MF A01

Three hot water systems and four hot air systems are evaluated. All are low-temperature projects (process heat at

temperatures below 212° F). Performance results, project costs, and problems encountered are summarized. Flat-plate, evacuated-tube, and line-focus collectors are all represented in the program, with collector array areas ranging from 2500 to 21,000 sq ft. Collector array efficiencies ranged from 12% to 38% with net system efficiences from 8% to 33%. Low efficiencies are attributable in some cases to high thermal losses and, for the two projects using air collectors, are due in part to high parasitic power consumption. Problems have included industrial effluents on collectors, glazing and absorber surface failures, excessive thermal losses, freezing and overheating, control problems, and data acquisition system failure. With design and data acquisition costs excluded costs of the projects ranged from $25/sq ft to $87/sq ft and $499/MBtu/yr to $1537/MBtu/yr. DOE

N81-32857# Altus Corp., San Jose, Calif.
FINAL DRAFT: IEA TASK 1. REPORT ON SUBTASK D, OPTIMIZATION OF SOLAR HEATING AND COOLING SYSTEMS
T. L. Freeman, ed. Mar. 1981 55 p refs
(Contract DE-AC03-80CS-30579)
(DOE/CS-30579/T1) Avail: NTIS HC A04/MF A01

A review of general techniques and specific methods useful in the optimization of solar heating and cooling systems is undertaken. A discussion of the state of the art and the principal problems in both the simplified thermal performance analysis and economic analysis portions of the optimization problem are presented. Sample economic analyses are performed using several widely used economic criteria. The predicted thermal results of one typical, widely used simplified method is compared to detailed simulation results. A methodology for and the results of a sensitivity study of key economic parameters in the life cycle cost method are presented. Finally, a simple graphical optimization technique based on the life cycle cost method is proposed. DOE

N81-32862# Zeopower Co., Natick, Mass.
DEVELOPMENT OF LOW-COST INTEGRATED ZEOLITE COLLECTOR Final Report, 25 Sep. 1978 - 24 Sep. 1980
Dimiter I. Tchernev Jul. 1981 96 p refs
(Contract DE-AC03-78CS-32117)
(DE81-027660; DOE/CS-32117/T1; DOE/SAN-2117/1) Avail: NTIS HC A05/MF A01

The optimum zeolite loading and the best zeolite for this purpose were determined by careful mathematical analysis, followed by experimental test, to confirm the theoretical results. The integrated collector design was then completed and the collector was constructed. After sealing and vacuum testing the zeolite panels and heat exchanges, the collector was coated with flat black paint and provided with double glazing, aluminum frame and insulation. Preliminary testing indicates close agreement with theoretical predictions of its performance. DOE

N81-32863# Department of Energy, Washington, D. C. Assistant Secretary for Conservation and Renewable Energy.
PHOTOVOLTAIC ENERGY SYSTEMS: PROGRAM SUMMARY
Jan. 1981 473 p
(DE81-028471; DOE/CE-0012) Avail: NTIS HC A20/MF A01

The ongoing research, development, and demonstration efforts of the Photovoltaics Program are highlighted and each of the US Department of Energy's current photovoltaics projects initiated or renewed during fiscal year 1980 is described. The program is briefly summarized, including the history and organization and highlights of advanced research and development, testing, and utilization in federal facilities. An exhaustive bibliography is included. DOE

N81-32866# Los Alamos Scientific Lab., N. Mex. Solar Energy Group.
DESIGN AND ANALYSIS OF DIRECT GAIN SOLAR HEATED BUILDINGS
William O. Wray Jun. 1981 119 p refs
(Contract W-7405-eng-36)
(DE81-026428; LA-8885-MS) Avail: NTIS HC A06/MF A01

Direct solar gains through south facing windows can supply a significant portion of the space heating needs of properly designed residential and light commercial buildings. The performance of a direct gain building depends on the climate, the solar collection area, the heat loss characteristics of the building envelope, the amount of thermal storage mass within the living space, and many other design parameters or options. This relationship is complex and can be fathomed only by a systematic research program involving both experimentation and analysis. Such a program was completed, and the results are presented in a form that is appropriate for quantitative thermal design. DOE

N81-32868# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR THERMAL ENERGY SYSTEMS RESEARCH AND ADVANCED DEVELOPMENT PROGRAM REVIEW
W. A. Hunt, comp. Apr. 1981 163 p refs Conf. held in Oakland, Calif., 8-9 Apr. 1981
(Contract DE-AC02-77CH-00178)
(SERI/CP-633-1145) Avail: NTIS HC A08/MF A01

Advancement in research and development in solar energy systems was investigated. The following topics are discussed: systems applications, fuel and chemicals research, solar materials research, and applied research. E.A.K.

N81-32869# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PREPARATION AND PROPERTIES OF EVAPORATED CdTe FILMS COMPARED WITH SINGLE CRYSTAL CdTe Progress Report, 1 Feb. - 30 Apr. 1981
Richard H. Bube 1981 29 p ref Prepared in cooperation with Stanford Univ.
(Contract DE-AC02-77CH-00178)
(SERI/PR-9330-1-T2) Avail: NTIS HC A03/MF A01

The design, constructing and testing of the hot wall vacuum evaporation system is discussed. A calculation of the optimum possible efficiency for an n-p CdTe homojunction indicates a value of 14%. A background is provided on the growth of over 50 CdTe single crystals. Use of crystal regrowth and vibration during growth both increase crystal quality. Initial investigation of the properties of grain boundaries in p-type CdTe:P crystals indicates a grain boundary height of 0.44 eV unaffected by illumination. It is suggested that grain boundaries are more strongly pinned in p-type than in n-type CdTe. DOE

N81-32872# Midwest Research Inst., Golden, Colo. Buildings Systems Development Branch.
ACTIVE CHARGE/PASSIVE DISCHARGE SOLAR HEATING SYSTEMS: THERMAL ANALYSIS AND PERFORMANCE COMPARISONS
Joel Swisher Jun. 1981 43 p refs
(Contracts DE-AC02-77CH-00178; EG-77-G-01-4042)
(DE81-027282; SERI/TR-721-1104) Avail: NTIS HC A03/MF A01

This type of system combines liquid-cooled solar collector panels with a massive integral storage component that passively heats the building interior by radiation and free convection. The TRNSYS simulation program is used to evaluate system performance and to provide input for the development of a simplified analysis method. This method, which provides monthly calculations of delivered solar energy, is based on Klein's Phi-bar procedure and data from hourly TRNSYS simulations. The method can be applied to systems using a floor slab, a structural wall, or a water tank as the storage component. Important design parameters include collector area and orientation, building heat loss, collector and heat exchanger efficiencies, storage capacity, and storage to room coupling. Performance simulation results are used for comparisons with active and passive solar designs. DOE

N81-32875# BDM Corp., Albuquerque, N. Mex.
CONCEPTUAL DESIGN AND ANALYSIS OF A 100-MWe DISTRIBUTED LINE FOCUS SOLAR POWER PLANT, VOLUME 1 Final Report
1981 269 p
(Contract DE-AC03-78ET-20524)
(DE81-025991; DOE/ET-20524/1-Vol-1) Avail: NTIS HC A12/MF A01

The concept of a Solar Power Plant is discussed. the following are included: executive summary, program overview, subsystem parametric analysis, system analysis and selection, conceptual design, and performance and cost summary. L.F.M.

N81-32677# Oak Ridge National Lab., Tenn. Energy Div.
APPLICATIONS OF HIGH-TEMPERATURE SOLAR HEAT TO THE PRODUCTION OF SELECTED FUELS AND CHEMICALS
S. E. Beall, Jr., C. E. Bamberger, and H. A. Goeller Jul. 1981 134 p refs
(Contract W-7405-eng-26)
(DE81-027070; ORNL/TM-7441) Avail: NTIS HC A07/MF A01

Processes requiring heat in the 1500 to 2500 range were investigated. Hydrogen production by several thermochemical mens, carbon monoxide production by thermochemical and direct thermal dissociation, and nitrogen fixation by direct thermal reaction of nitrogen and oxygen in air are considered. The engineering feasibility of the processes is discussed. The problem of matching the conventional and innovative processes to a high temperature solar supply was studied. Some solar thermal power plants of current designs were examined and several advanced concepts of highly concentrating systems are considered for very high temperature applications. DOE

N81-32678# Sandia Labs., Albuquerque, N. Mex. Photovoltaic Data and Information Systems Div.
INTERMEDIATE PHOTOVOLTAIC-SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 1: FOR MT. LAGUNA RADAR STATION SITE, MT. LAGUNA, CALIF.
Jul. 1981 18 p Prepared in cooperation with Boeing Computer Services Co., Seattle
(Contract DE-AC04-76DP-00789)
(SAND-81-7090/1; DE81-028189) Avail: NTIS HC A02/MF A01

A program for constructing a remote military photovoltaic power network and for demonstrating that a dc-ac photovoltaic energy conversion system, without on site energy storage, can effectively augment a diesel-powered electric grid, is outlined. Included are a list of peticipants, insolation and operating data, definitions of operational and data collection modes, system specifications and subsystem descriptions. DOE

N81-32680# General Electric Co., Sunnyvale, Calif. Advanced Reactor Systems Dept.
THERMAL PERFORMANCE AND DYNAMIC STABILITY OF SOLAR PILOT PLANT RECEIVER PANEL TEST OF CRTF
E. A. Hernandez Jan. 1981 43 p refs
(Contract DE-AC04-76DP-00789)
(ARSD-00088; SAND-81-8181) Avail: NTIS HC A03/MF A01

Thermal performance of a solar heated boiler panel is reported. The test panel geometry incorporates design features and pilot plant operating conditions are simulated. Overall thermal performance and axial distribution of temperatures and absorbed heat flux are predicted with a steady state code included. Differential pressure and temperature oscillations are identified as characteristic of density wave dynamic channel instability. Selective experimentally determined unstable conditions are also predicted to be unstable with a state of the art dynamic stability code, STEAMFREQ-I. DOE

N81-32681# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
THE 10 MWe SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT SOLAR FACILITIES DESIGN INTEGRATION, RADL ITEM 1-10 Technical Status Report
Jul. 1980 20 p
(Contract DE-AC03-79SF-10499)
(DOE/SF-10499/T37) Avail: NTIS HC A02/MF A01

Accomplishments are reported in the areas of: program management, system integration, the beam characterization system, receiver unit, thermal storage subsystems, master control system, plant support subsystem and engineering services. A solar facilities design integration program action items update is included. Work plan changes and cost underruns are discussed briefly. (LEW) DOE

N81-32682# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
THE 10 MWe SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT SOLAR FACILITIES DESIGN INTEGRATION, RADL ITEM 1-10 Technical Status Report
Aug. 1980 18 p
(Contract DE-AC03-79SF-10499)
(DOE/SF-10499/T38) Avail: NTIS HC A02/MF A01

Work on the plant support subsystems and engineering services is reported. The master control system, thermal storage subsystem, receiver unit, and the beam characterization system were reviewed. Progress in program management and system integration is highlighted. T.M.

N81-32683# BDM Corp., Albuquerque, N. Mex.
CONCEPTUAL DESIGN AND ANALYSIS OF 100 MWe DISTRIBUTED LINE FOCUS SOLAR POWER PLANT Final Report
[1981] 336 p refs
(Contract DE-AC03-78ET-20524)
(DE81-025572; DOE/ET-20524/1-Vol-2) Avail: NTIS HC A15/MF A01

The several efficiency of the ski model t-700 lpt solar collector with varied RTS configurations, and the analytical efficiency models of the CS/RTS were validated. Efficiency is determined as a function of solar insolation and average collector thermal transfer fluid temperature. There different receiver tube/annulus and two thermal transfer fluids are used for each configuration. E.A.K.

N81-32684# Energy Technology Engineering Center, Canoga Park, Calif.
TC-100 SOLAR-COLLECTOR REVIEW PROGRAM Final Summary Report
A. J. Darnell, W. P. Marlatt, and J. K. Roberts Jun. 1981 54 p refs
(Contract DE-AC03-76SF-00700)
(DE81-028762; ETEC-TDR-81-3) Avail: NTIS HC A04/MF A01

Field and laboratory tests, materials investigation and tests, and thermal modeling work were conducted to determine the extent and effect of serpentine oxidation on thermal performance of the TC-100 solar collector. This work included measurements at six field installations to determine the extent of atmospheric fin oxidation on typical solar collectors at each site. Thermal efficiency performance tests were conducted at the Gilroy Foods solar installation. Field performance tests were conducted separately on the two essentially identifically constructed halves of this solar collector installation which had experienced significantly different periods of stagnation, i.e., subjected to solar insolation without coolant flow. DOE

N81-32690# Sandia Labs., Albuquerque, N. Mex.
LINE-FOCUS CONCENTRATING SOLAR COLLECTORS
James A. Leonard and Virgil L. Dugan 1980 9 p Presented at the Conf. on New and Renewable Energy Sources, Nairobi, Kenya, Aug. 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2394C; CONF-810802-1) Avail: NTIS HC A02/MF A01

An overview of the line focus concentrating solar collector technology and applications is presented. The collectors, some of the key features of the engineering approach, instantaneous and all day performance and operating data, temperature capabilities and limitations for selected collectors, projected future capabilities for peak and annual performance are described. Projected system capital costs and annualized life cycle cost for thermal energy produced are discussed. Several existing application projects which employ line concentrating collectors are reviewed. DOE

N81-32692# Applied Research Association, Inc., Albuquerque, N. Mex.
FULL SCALE LOAD TESTS OF EXPERIMENTAL SOLAR COLLECTOR FOUNDATIONS
D. H. Merkle Jun. 1981 114 p refs Presented at the ASCE Spring Conf., Las Cruces, N. Mex., 27 Mar. 1981 Prepared for Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-026044; SAND-80-7076; CONF-810341-1) Avail: NTIS HC A06/MF A01

Four drilled, reinforced concrete piers typical of foundations utilized for single axis tracking solar collector systems were tested

to failure under both eccentric lateral and vertical loads. The tests showed the need to improve the foundation anchor bolt assembly, and also the method of mounting for collectors to the foundations. The lateral and vertical failure loads and moments of all four piers well exceeded specified design values. DOE

N81-32699# MacMillan Co. of India, Madras.
PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON BIOLOGICAL APPLICATIONS OF SOLAR ENERGY
A. Gnanam, ed., S. Krishnaswamy, ed. (Maduraj Kamaraj Univ., India), and Joseph S. Kahn, ed. (North Carolina State Univ. at Raleigh) 1980 231 p refs Conf. held at Maduraj, India, 1-5 Dec. 1978
(PB81-195307) Copyright. Avail: NTIS HC A11/MF A01 CSCL 10B

Solar energy harvesting through photosynthetic means for biomass and biofuel production is discussed. Global and regional aspects of solar energy photosynthesis and productivity, nitrogen fixation, biomass, extreme environment, model systems, and biofuels and chemicals are addressed. GRA

N81-32701# National Bureau of Standards, Washington, D.C. Center for Building Technology.
UNCERTAINTY IN DETERMINING THERMAL PERFORMANCE OF LIQUID-HEATING FLATPLATE SOLAR COLLECTORS Final Report
Elmer Streed and David Waksman Apr. 1981 102 p refs Sponsored in part by DOE
(PB81-205452; NBS-TN-1140) Avail: NTIS HC A06/MF A01 CSCL 10A

Thermal performance measurements of eight liquid-heating flat-plate solar collectors are presented. Statistical anaysis of data, sets for each collector type within test sites and between test sites was done using ASTM recommended methods to evaluate test method measurement uncertainty. The influence of thermal performance data uncertainty on collector material degradation, collector rating, and calculated system performance is described. GRA

N81-32703# Illinois Inst. of Natural Resources, Springfield. Solar Energy Sect.
F-CHART HANDBOOK. ACTIVE SOLAR SYSTEM SIZING AND ECONOMIC ANALYSIS PROGRAM
Gary W. Mielke Apr. 1981 15 p
(PB81-210551; ILLDOE-81/01) Avail: NTIS HC A02/MF A01 CSCL 13A

The program is applicable to active solar space and service water heating systems that incorporate typical flat-plate solar collectors. The program is based on the F-Chart method of estimating annual system thermal performance. This program uses a standard life-cycle cost analysis methodology to calculate optimum solar system size and present economic performance data. The F-Chart program is designed to be used by anyone interested in, or involved with, solar heating systems. This handbook describes both information input requirements and the resultant thermal and economic analyses. GRA

N81-33222*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SYSTEMS TEST FACILITIES EXISTING CAPABILITIES COMPILATION
Robert Weaver 1 Aug. 1981 45 p refs
(Contracts NAS7-100; DE-A101-76ET-20356; JPL Proj. 5240-3) (NASA-CR-164851; DOE/ET-20356/1; JPL-Pub-81-14) Avail: NTIS HC A03/MF A01 CSCL 14B

Systems test facilities (STFS) to test total photovoltaic systems and their interfaces are described. The systems development (SD) plan is compilation of existing and planned STFs, as well as subsystem and key component testing facilities. It is recommended that the existing capabilities compilation is annually updated to provide and assessment of the STF activity and to disseminate STF capabilities, status and availability to the photovoltaics program. E.A.K.

N81-33313# New Hampshire Univ., Durham. Dept. of Chemical Engineering.
SOLAR-ENHANCED COAL GASIFICATION USING HIGH-TEMPERATURE SOLAR ENERGY
S. M. Lakshmanan, F. K. Manasse, and V. K. Mathur 1980 21 p refs Presented at the Natl. Solar Energy Conv., Annamalainagar, India, Dec. 1980
(Contract DE-AC02-79ET-21067)
(DE81-025020; CONF-801284-1) Avail: NTIS HC A02/MF A01

A fluidized bed coal gasification system using solar energy for the production of synthesis gas is described. The problems relating to its commercialization are also discussed. DOE

N81-33386# Los Alamos Scientific Lab., N. Mex.
ATTACHED-SUNSPACE PASSIVE SOLAR-HEATED RESIDENCES: A STUDY OF NATIONWIDE PATTERNS OF ECONOMIC FEASIBILITY FOR THE EXISTING HOUSING STOCK
F. Rosch and C. Kirschner Jun. 1981 135 p
(Contract W-7405-eng-36)
(DE81-026309; LA-8889-MS) Avail: NTIS HC A07/MF A01

Performance estimates for attached-sunspace passive solar-heated residences were incorporated into the Los Alamos/UNM EASE 3 Model. These estimates are used to analyze the economic performance of a passive sunspace design when retrofitting onto an existing single-family home. Several key parameters are evaluated, including loan or mortgage terms, ownership period, resale potential, and competing conventional fuel prices. General economic and design parameters are combined in one version of life-cycle costing to evaluate the feasibility of both owner-built and contractor-built attached sunspaces for 220 regions in the contiguous US. The conventional fuel alternatives are natural gas, heating oil, electric resistance, and electric heat pump. The optimal sunspace design in determined for the fuel alternatives by minimizing the combined solar and conventional delivered cost of heat. An analysis of fuel used for space heating in existing homes is used to discuss the retrofit potential for the 220 regions. Results show that the prospect for conventional fuel displacement through retrofit of attached sunspace is very good, and that the design's economic performance is enhanced in regions with expensive conventional fuel alternatives. DOE

N81-33414# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
INVESTIGATION OF A FAMILY OF POWER CONDITIONERS INTEGRATED INTO A UTILITY GRID: CATEGORY 1 Final Report
P. Wood and R. P. Putkovich Jul. 1981 107 p Prepared for Sandia National Lab.
(Contracts DE-AC04-76DP-00789; DE-AC02-79ET-29359)
(DE81-029394; SAND-81-7030) Avail: NTIS HC A06/MF A01

Technical issues regarding ac and dc interface requirements were studied. A baseline design was selected to be a good example of existing technology which would not need significant development effort for its implementation in residential solar photovoltaic systems. Alternative technologies are evaluated to determine which meet the baseline specification, and their costs and losses are evaluated. Areas in which cost improvements can be obtained are studied, and the three best candidate technologies--the current sourced converter, the HF front end converter, and the programmed wave converter--are compared. It is concluded that the designs investigated will meet, or with slight improvement could meet, short term efficiency goals. Long term efficiency goals could be met if an isolation transformer were not required in the power conditioning equipment. None of the technologies studied can meet cost goals unless further improvements are possible. DOE

N81-33496*# Boeing Engineering and Construction, Seattle, Wash.
WIND LOADS ON FLAT PLATE PHOTOVOLTAIC ARRAY FIELDS (NONSTEADY WINDS) Final Report
Ronald D. Miller and Donald K. Zimmerman Aug. 1981 96 p refs Sponsored by NASA and DOE Prepared for JPL, California Inst. of Tech., Pasadena
(Contract JPL-954833)
(NASA-CR-164745; DOE/JPL-954833-81/4; JPL-9950-594) Avail: NTIS HC A05/MF A01 CSCL 20K

Techniques to predict the dynamic response and the structural dynamic loads of flat plate photovoltaic arrays due to wind turbulence were analyzed. Guidelines for use in predicting the turbulent portion of the wind loading on future similar arrays

are presented. The dynamic response and the loads dynamic magnification factor of the two array configurations are similar. The magnification factors at a mid chord and outer chord location on the array illustrated and at four points on the chord are shown. The wind tunnel test experimental rms pressure coefficient on which magnification factors are based is shown. It is found that the largest response and dynamic magnification factor occur at a mid chord location on an array and near the trailing edge. A technique employing these magnification factors and the wind tunnel test rms fluctuating pressure coefficients to calculate design pressure loads due to wind turbulence is presented. E.A.K.

N81-33803*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A COMPARATIVE ASSESSMENT OF SOLAR THERMAL ELECTRIC POWER PLANTS IN THE 1-10 MWe RANGE
L. S. Rosenberg and W. R. Revere Jun. 1981 80 p refs
(Contracts NAS7-100; DE-AT04-81AL-16228; JPL Proj 5105-88)
(NASA-CR-164854; JPL-Pub-81-53; DOE/JPL-1060/21) Avail: NTIS HC A05/MF A01 CSCL 10A

The candidate power system technologies were ranked in terms of the cost of electric energy each system produces. In all cases, it was assumed that development programs would result in mature power plant systems that could be commercially manufactured. The results of the study, a brief description of the systems examined, and the methodologies used are presented. T.M.

N81-33804*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EVALUATION OF THE EFFECTS OF A FREEZE/THAW ENVIRONMENT ON CELLULAR GLASS
P. Frickland, E. Cleland, and T. Hasegawa 15 Aug. 1981 73 p refs
(Contract NAS7-100; DE-AT04-81AL-16228; JPL Proj. 5105-81)
(NASA-CR-164856; JPL-Pub-81-29; DOE/JPL-1060/44) Avail: NTIS HC A04/MF A01 CSCL 01A

Using the evaluation criteria of water vapor permeability and conformability, a protective butylrubber/silicone conformal coating system was selected for use on Foamglas substrates in a freeze/thaw environment. The selection of a specific freeze/thaw cycle which closely models field conditions is discussed. A sampling plan is described which allows independent evaluation of the effects of conformal coatings, cycle number and location within the environmental chamber. The results of visual examination, measurement of density, modulus of rupture and Young's modulus are reported. Based upon statistical evaluation of the experimental results, it is concluded that no degradation in mechanical properties of either coated or uncoated Foamglas occurred within the duration of the test (53 freeze/thaw cycles). T.M.

N81-33805*# Spire Corp., Bedford, Mass.
INTEGRAL GLASS ENCAPSULATION FOR SOLAR ARRAYS Final Report
G. A. Landis Jul. 1981 79 p refs Sponsored in part by DOE Prepared for JPL
(DOE/JPL-954521-81/15; JPL-9950-589; FR-81-10048) Avail: NTIS HC A05/MF A01

Electrostatic bonding technology, an encapsulation technique for terrestrial solar array was developed. The process produces full integral, hermetic bonds with no adhesives or pottants. Panels of six solar cells on a simple glass superstrate were produced. Electrostatic bonding for making the cell front contact was also developed. A metal mesh is trapped into contact with the cell front during the bonding process. Six cell panels using the bonded mesh as the only cell front contact were produced. The possibility of using lower cost glass, with a higher thermal expansion mismatch to silicon, by making lower temperature bonds is developed. However, this requires a planar surface cell. E.A.K.

N81-33806*# California Inst. of Tech., Pasadena.
EVALUATION AND VERIFICATION OF EPITAXIAL PROCESS SEQUENCE FOR SILICON SOLAR CELL PRODUCTION Quarterly Report, 1 Apr. - 30 Jun. 1981
D. Redfield Jul. 1981 21 p refs Sponsored in part by DOE Prepared for JPL
(Contract NAS7-100)
(NASA-CR-164875; DOE/JPL-955825-81/2; JPL-9950-590; QR-2) Avail: NTIS HC A02/MF A01 CSCL 10A

The applicability of solar cell and module processing sequences, to be used on lower cost epitaxial silicon wafers was evaluated. The extent to which the process sequences perform effectively when applied to film solar cells formed by epitaxial deposition of Si on potentially inexpensive substrates of upgraded metallurgical grade Si is examined. It is concluded that these substrates are satisfactory in their cell performance. E.A.K.

N81-33807*# Pennsylvania Univ., Philadelphia.
ANALYSIS AND EVALUATION IN THE PRODUCTION PROCESS AND EQUIPMENT AREA OF THE LOW-COST SOLAR ARRAY PROJECT Final Report
M. Wolf Apr. 1981 319 p refs Sponsored by NASA and DOE Prepared for JPL, California Inst. of Tech., Pasadena
(Contract JPL-954976)
(NASA-CR-164867; DOE/JPL-954976-81/13) Avail: NTIS HC A14/MF A01 CSCL 10A

The effect of solar cell metallization pattern design on solar cell performance and the costs and performance effects of different metallization processes are discussed. Definitive design rules for the front metallization pattern for large area solar cells are presented. Chemical and physical deposition processes for metallization are described and compared. An economic evaluation of the 6 principal metallization options is presented. Instructions for preparing Format A cost data for solar cell manufacturing processes from UPPC forms for input into the SAMIC computer program are presented. J.D.H.

N81-33808*# Westinghouse Electric Corp., East Pittsburgh, Pa. Advanced Energy Systems Div.
A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT (MEPSDU) Quarterly Report, 1 Jun. - 31 Aug. 1981
31 Aug. 1981 61 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955909)
(NASA-CR-164877; DOE/JPL-955909-81/3; JPL-9950-595; QR-3) Avail: NTIS HC A04/MF A01 CSCL 10A

Subsequent to the design review, a series of tests was conducted on simulated modules to demonstrate that all environmental specifications (wind loading, hailstone impact, thermal cycling, and humidity cycling) are satisfied by the design. All tests, except hailstone impact, were successfully completed. The assembly sequence was simplified by virtue of eliminating the frame components and assembly steps. Performance was improved by reducing the module edge border required to accommodate the frame of the preliminary design module. An ultrasonic rolling spot bonding technique was selected for use in the machine to perform the aluminum interconnect to cell metallization electrical joints required in the MEPSDU module configuration. This selection was based on extensive experimental tests and economic analyses. T.M.

N81-33810*# General Electric Co., Philadelphia, Pa. Energy Systems and Technology Div.
INTEGRATED RESIDENTIAL PHOTOVOLTAIC ARRAY DEVELOPMENT
N. F. Shepard, Jr. 14 Aug. 1981 74 p Sponsored by NASA and DOE Prepared for JPL, Pasadena, Calif.
(Contract JPL-955894)
(NASA-CR-164865; DOE/JPL-955894-3) Avail: NTIS HC A04/MF A01 CSCL 10A

The design details of an optimized integrated residential photovoltaic module/array are presented. This selected design features a waterproofing and mounting scheme which was devised to simplify the installation procedures by the avoidance of complex gasketed or caulked joints, while still maintaining a high confidence that the watertight integrity of the integral roofing surface will be achieved for the design lifetime of the system. The production and installation costs for the selected module/array design are reported for a range of annual production rates as a function of the cost of solar cells. M.G.

N81-33811*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR COOLING SYSTEM PERFORMANCE, FRENCHMAN'S REEF HOTEL, VIRGIN ISLANDS Final Report
Harry Harbor 28 Sep. 1981 26 p refs
(Contracts DEN8-00005; DEN8-00007; DEN8-0000021)

(NASA-TM-82442) Avail: NTIS HC A02/MF A01 CSCL 10A

The operational and thermal performance of a variety of solar systems are described. The Solar Cooling System was installed in a hotel at St. Thomas, U. S. Virgin Islands. The system consists of the evacuated glass tube collectors, two 2500 gallon tanks, pumps, computerized controller, a large solar optimized industrial sized lithium bromide absorption chiller, and associated plumbing. Solar heated water is pumped through the system to the designed public areas such as lobby, lounges, restaurant and hallways. Auxiliary heat is provided by steam and a heat exchanger to supplement the solar heat. E.A.K.

N81-33612*# LinCom Corp., Pasadena, Calif.
SOLAR POWER SATELLITE ANTENNA PHASE CONTROL SYSTEM HARDWARE SIMULATION, PHASE 4: VOLUME 1: EXECUTIVE SUMMARY Final Report
W. C. Lindsey, A. V. Kantak, and C. M. Chie Mar. 1981 22 p refs 3 Vol.
(Contract NAS9-16097)
(NASA-CR-167393; TR-0381-1280-Vol-1) Avail: NTIS HC A02/MF A01 CSCL 10A

The phase control system is described. Potential sources of phase error are identified and the performance leading to selection of the allowable phase error for each source is summarized. The pilot transmitter, the effects of ionospheric, the master slave returnable timing system (MSRTS), the SPS receiver, and the high power amplifier for dc to microwave conversion are considered separately. Design parameters of the pilot transmitter and spacetenna transponder are presented. J.D.H.

N81-33613*# LinCom Corp., Pasadena, Calif.
SOLAR POWER SATELLITE ANTENNA PHASE CONTROL SYSTEM HARDWARE SIMULATION, PHASE 4. VOLUME 2: ANALYTICAL SIMULATION OF SPS SYSTEM PERFORMANCE Final Report
W. C. Lindsey, A. V. Kantak, and C. M. Chie Mar. 1981 93 p refs 3 Vol.
(Contract NAS9-16097)
(NASA-CR-167394; TR-0381-1280-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 10A

The pilot signal parameter optimization and power transponder analyses are presented. The SPS antenna phase control system is modeled and the hardware simulation study described. Ionospheric and system phase error effects and the effects of high power amplifier phase and amplitude jitters are considered. Parameter optimization of the spread spectrum receiver, consisting of the carrier tracking loop and the code tracking loop, is described. J.D.H.

N81-33614*# LinCom Corp., Pasadena, Calif.
SOLAR POWER SATELLITE ANTENNA PHASE CONTROL SYSTEM HARDWARE SIMULATION, PHASE 4. VOLUME 3: SOLARSIM USERS MANUAL Final Report
W. C. Lindsey, A. V. Kantak, and C. M. Chie Mar. 1981 41 p refs 3 Vol.
(Contract NAS9-16097)
(NASA-CR-167395; TR-0381-1280-Vol-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Documentation of the interactive software package designed to predict the effect of certain electrical and mechanical imperfections on the performance of the SPS system is presented. The capabilities of the SOLARSIM program to quantify the spacetenna performance parameter values are described. The SOLARSIM package can compute the RMS pointing error, title effects, MPTX code tracking loop performance, MPTX carrier tracking loop performance, averaged power pattern, and the power transfer efficiency. J.D.H.

N81-33616# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NUMERICAL SOLUTION OF NATURAL CONVECTION IN AN INCLINED RECTANGULAR CAVITY WITH PARTITIONS M.S. Thesis
Thomas K. Toltzien Dec. 1980 96 p refs
(AD-A103389; AFIT/GAE/AA/80D-23) Avail: NTIS HC A05/MF A01 CSCL 10/1

A numerical investigation was conducted on two-dimensional natural convection within inclined rectangular enclosures partitioned into 45 degree triangular cells. The time dependent governing equations, vorticity, energy, and stream function, were solved by an ADI method and a Gauss-Seidel SOR technique. The numerical procedure was validated for rectangular enclosures, then modified for triangular cells. Heat transfer coefficients were determined for an inclined square enclosure with a diagonal partition for Grashof numbers less than 200,000 and inclination angles between 10 degrees and 90 degrees. These results show a diagonal partition reduces the heat transferred by natural convection across an inclined square enclosure by more than 50%. Author (GRA)

N81-33623# Florida Solar Energy Center, Cape Canaveral.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 1: THE STATE OF SOLAR ENERGY TECHNOLOGY
D. L. Block Apr. 1981 27 p refs
(Contract DE-FC02-79CS-30278)
(DE81-029002; DOE/CS-30278/T15) Avail: NTIS HC A03/MF A01

The state of solar energy technology, economic considerations, problems/needs, and suggested government is assessed. Solar industry and state and local government actions are discussed. The federal government programs and the role of the federal government are emphasized. It is anticipated that the photovoltaics, passive, biomass, hot water, space heating and wind programs are all within short term of the private marketplace. DOE

N81-33626# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SIMULATED PERFORMANCE OF THE STAND-ALONE PHOTOVOLTAIC SYSTEM AT NATURAL BRIDGES NATIONAL MONUMENT
B. L. Grossman Mar. 1981 39 p
(Contract DE-AC02-76ET-20279)
(DE81-027274; DOE/ET-20279/125) Avail: NTIS HC A03/MF A01

A stand alone photovoltaic (PV) system was evaluated. A computer model was used to describe and analyze the individual system components and the performance of the system as a whole. Various methods of looking at system performance are identified and explored: (1) available array energy; (2) yearly energy flow; and (3) load categorization. These methods provide a basis for design and operational refinements as well as a reference for future analyses using actual data. DOE

N81-33627# Sandia Labs., Albuquerque, N. Mex.
HANDBOOK FOR THE CONCEPTUAL DESIGN OF PARABOLIC TROUGH SOLAR ENERGY SYSTEMS PROCESS HEAT APPLICATIONS
R. W. Harrigan Jul. 1981 320 p refs
(DE81-029290; SAND-81-0763) Avail: NTIS HC A14/MF A01

This report presents the techniques needed to execute conceptual designs of process heat systems employing parabolic trough solar collectors. The design tools are presented in graphical format, and each of 26 SOLMET sites is explicitly represented. The conceptual design resultant from the application of the design charts contained within this handbook approximates the collector area needed to displace a constant thermal demand, the land area needed for collector deployment, the appropriate quantity of sensible heat storage, the fraction of fossil fuel displaced by solar, and the capital cost of the collector-storage subsystem. DOE

N81-33628# Sandia Labs., Albuquerque, N. Mex. Dept. of Solar Energy Projects.
MODULAR INDUSTRIAL SOLAR RETROFIT SYSTEM CONSTRAINTS, SPECIFICATIONS, AND GUIDELINES
Karl Wally, ed. Aug. 1981 60 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029289; SAND-81-1300) Avail: NTIS HC A04/MF A01

A programmatic, physical and regulatory reference environment for which the systems shall be designed is defined. This encompasses a large segment of process steam applications, so that system designs developed for it will be widely applicable with little or no modification. Minimum design requirements at all levels are detailed, and design methodologies, features, and practices are recommended for consideration in any MISR design. DOE

N81-33829# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
ORGANIC RANKINE CYCLE COUPLED TO A SOLAR POND BY DIRECT-CONTACT HEAT EXCHANGE: SELECTION OF A WORKING FLUID
John D. Wright Jun. 1981 35 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-029400; SERI/TR-631-1122) Avail: NTIS HC A03/MF A01

The saturated and halogenated hydrocarbons for use as working fluids were evaluated. It is posited that heat from a solar pond may be used to drive an organic Rankine cycle and produce electricity. Use of a direct contact boiler, in which the organic fluid is bubbled through a stream of pond brine, may reduce the plant cost by about 25%. Low vapor pressure fluids maximize cycle efficiency by minimizing pumping requirements, but require a larger turbine. It is found that pentane is the working fluid best suited to this application because of its high efficiency, low solubility in the pond, and reasonable turbine cost. DOE

N81-33830# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC-SYSTEM APPLICATION: EXPERIMENT OPERATIONAL PERFORMANCE REPORT, VOLUME 1 FOR NEWMAN POWER STATION SITE, EL PASO, TEXAS
Jul. 1981 16 p Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-029283; SAND-81-7066/1) Avail: NTIS HC A02/MF A01

A project is described for application of a photovoltaic power supply to computers that control the operation of a combined cycle power plant. The photovoltaic power supply will be used with an existing DC facility. The project is briefly outlined, and the participants are listed. Relevant weather data and reference operating conditions are given and four operational and collection modes are described. System specifications are given and the solar array, protection, and data acquisition and instrumentation subsystems are described. DOE

N81-33831# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION: FIRST MANUFACTURED HOMES (LOT 219) SINGLE FAMILY RESIDENCE, LUBBOCK, TEXAS
D. Moore 21 Aug. 1981 50 p
(Contracts DE-AB01-76CS-31020; HUD-H-2372)
(DE81-028120; SOLAR/1047-81/50) Avail: NTIS HC A03/MF A01

A system designed to provide solar space heating and to preheat domestic hot water is described. The collector, storage, energy to load, and auxiliary subsystems are described. Operation of the solar and auxiliary systems may involve one or more of five modes of operations: collector to storage, direct solar to space heating, storage to space heating, preheating domestic hot water, and auxiliary space heating. Original cost estimates for provisioning and installation of the solar system are given. DOE

N81-33835# Sandia Labs., Albuquerque, N. Mex. Energy Systems and Technology Div.
DESIGN OF A PHOTOVOLTAIC SYSTEM WITH ON-SITE STORAGE FOR A SOUTHWEST ALL-ELECTRIC RESIDENCE
E. M. Mehalick, R. Felice, G. J. Tully, J. Johnson, J. Parker, and G. OBrien Jun. 1981 220 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029282; SAND-80-7170) Avail: NTIS HC A10/MF A01

The design of a photovoltaic residence employing on-site storage has been developed for a south-western site. Performance data is provided for Phoenix and Albuquerque locations. The roof mounted array is typical of projected retrofit installations. Detailed installation and electrical drawings are provided. DOE

N81-33838# Northrup, Inc., Hutchins, Tex.
SECOND-GENERATION HELIOSTAT DEVELOPMENT, VOLUME 2. Final Report, 16 Jul. 1979 - 31 Mar. 1981
Mar. 1981 172 p refs Prepared in cooperation with Bechtel National, Inc. and Booz-Allen and Hamilton, Inc. Prepared for Sandia National Labs.
(Contract DE-AC04-76DP-00789)
(DE81-028869; SAND-81-8178-Vol-2) Avail: NTIS HC A08/MF A01

The designs, methods, and procedures involving the field assembly and installation of heliostats are described. About 50% of the maintenance cost is related to mirror washing. Mechanical maintenance, constituting about 35% of the total, involves clean up and painting of steel parts. Electrical and electronic components maintenance is also discussed. The cost per installed heliostat and the annual cost of owning, operating and maintaining a collector subsystem for a 50 MWe (peak) solar central receiver electrical power plant are determined. DOE

N81-33841# Yale Univ., New Haven, Conn.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 2: PASSIVE SOLAR TECHNOLOGY
Donald Watson Apr. 1981 61 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029003; DOE/CS-30278/T16-Vol-2) Avail: NTIS HC A04/MF A01

The status of passive solar heating and cooling for residential, commercial, and agricultural applications, and of daylighting is summarized. Passive solar energy is used in the broad sense describing a comprehensive approach to design that considers all climatic impacts on a building, and includes planning on the multi-building scale. The key roles of the designer and of innovation in the building industry are discussed. Numerous terms are defined and the origins of several are discussed. Passive design principles are summarized. Performance and costs of passive solar technologies are examined. Passive energy design tools and methods are considered in the context of the overall process by which building decisions are made to achieve the integration of new techniques into conventional design. DOE

N81-33842# Colorado State Univ., Fort Collins.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 3: ACTIVE SPACE HEATING AND HOT WATER SUPPLY WITH SOLAR ENERGY
S. Karaki and G. O. G. Loef Apr. 1981 35 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029004; DOE/CS-30278/T12-Vol-3) Avail: NTIS HC A03/MF A01

Several types of solar water heaters are described and assessed. These include thermosiphon water heaters and pump circulation water heaters. Auxiliary water heating is briefly discussed, and new and retrofit systems are compared. Liquid-based space heating systems and solar air heaters are described and assessed, auxiliary space heating are discussed, and new and retrofit solar space heating systems are compared. The status of flat plate collectors, evacuated tube collectors, and thermal storage systems is examined. Systems improvements, reliability, durability and maintenance are discussed. The economic assessment of space and water heating systems includes a comparison of new systems costs with conventional fuels, and sales history and projections. The variety of participants in the solar industry and users of solar heat is discussed, and various incentives and barriers to solar heating are examined. Several policy implications are discussed, and specific government actions are recommended. DOE

N81-33843# Arizona State Univ., Tempe. College of Architecture.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 4: SOLAR AIR CONDITIONING: ACTIVE, HYBRID AND PASSIVE
John I. Yellott Apr. 1981 58 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029005; DOE/CS-20278/T5-Vol-4) Avail: NTIS HC A04/MF A01

The status of absorption cycle solar air conditioning and the Rankine cycle solar cooling system is reviewed. Vapor jet ejector chillers, solar pond based cooling, and photovoltaic compression air conditioning are also briefly discussed. Hybrid solar cooling by direct and indirect evaporative cooling, and dehumidification by desiccation are described and discussed. Passive solar cooling by convective and radiative processes, evaporative cooling by passive processes, and cooling with roof ponds and movable

modation are reviewed. Federal and state involvement in solar cooling is discussed. DOE

N81-33644# Tennessee Univ., Knoxville. Energy, Environment and Resources Center.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 5: SOLAR INDUSTRIAL PROCESS HEAT
Edward Lumsdaine Apr. 1981 82 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029006; DOE/CS-30278/T7-Vol-5) Avail: NTIS HC A05/MF A01

The Solar Industrial Process Heat (SIPH) assessment is done to candidly examine the contribution SIPH is realistically able to make in the near and long-term energy futures of the United States. The performance history of government and privately funded SIPH demonstration projects and the present status of SIPH technology are discussed. Before making final recommendations, the influence of economic and socio-political factors (which have a very large effect on the acceptability and application of any new, alternate energy technology) are considered. Focus is on evacuated tube, parabolic trough, and multiple reflector solar collectors. Auxiliary equipment which is part of a SIPH system such as pumps, blowers, controls, and heat exchangers and storage (where applicable) are also discussed. DOE

N81-33645# Arizona Univ., Phoenix.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 6: PHOTOVOLTAIC TECHNOLOGY ASSESSMENT
Charles E. Backus Apr. 1981 41 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029007; DOE/CS-30278/T9-Vol-6) Avail: NTIS HC A03/MF A01

Industrial production of photovoltaic systems and volume of sales are reviewed. Low cost silicon production techniques are reviewed, including the Czochralski process, heat exchange method, edge defined film fed growth, dentritic web growth, and silicon on ceramic process. Semicrystalline silicon, amorphous silicon, and low cost poly-silicon are discussed as well as advanced materials and concentrator systems. Balance of system components beyond those needed to manufacture the solar panels are included. Nontechnical factors are assessed. The 1986 system cost goals are briefly reviewed. DOE

N81-33647# Houston Univ., Tex. Energy Lab.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 9: HELIOSTAT SYSTEMS: TECHNICAL AND ECONOMIC ASSESSMENT
A. F. Hildebrandt and C. L. Laurence Apr. 1981 92 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029010; DOE/CS-30278/T13-Vol-9) Avail: NTIS HC A05/MF A01

An extensive review of the literature is provided on heliostat central receiver systems including subsystem design and research experiments, full scale system designs, assessments, evaluations, rankings, application and marketing studies, and heliostat manufacturing studies. The current status of heliostat system development is reviewed and assessed. Recent design reports are examined, and expected economic and performance improvements are reported. Recommendations are made for the role that government can play in heliostat systems development, and for state and federal policies for development of solar commercialization and the formation of heating utilities. DOE

N81-33648# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Mechanics.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 11: THE SOLAR INDUSTRY IN THE UNITED STATES: ITS STATUS AND PROSPECTS, 1981
John A. Clark Apr. 1981 47 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029030; DOE/CS-30278/T8-Vol-11) Avail: NTIS HC A03/MF A01

The energy production goals for the solar industry, and the industry's present status are described. Manufacturing and sales of low and medium temperature solar collectors from 1974 to 2000 are analyzed, and the HUD/DOE solar demonstration programs' relative merits are discussed. Certain characteristics of the conventional water heating industry are briefly described. DOE

N81-33650# Western Sun, Portland, Oreg.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 12: STATE AND COMMUNITY COMMERCIALIZATION ISSUES
Ronald D. Doctor and Janice Hamrin (Alliance for Renewable Energy, Sacramento, Calif.) Apr. 1981 87 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30278)
(DE81-029087; DOE/CS-30278/T14-Vol-12) Avail: NTIS HC A04/MF A01

The need to overcome economic and institutional barriers and make the transition to using renewable energy sources is briefly explained, and advantages to implementation of solar technology on the state and local government levels are discussed. The role of government involvement is defined, and the gathering and dissemination of information are discussed. Consumer protection; reliability assurance; and redress for problems. Each of these parts is discussed. Mandates, economic incentives, and subsidies are described and analyzed. DOE

N81-33651# Spectrolab, Inc., Sylmar, Calif.
CONCEPTUAL DESIGN AND SYSTEM ANALYSIS STUDY FOR A HYBRID SOLAR PHOTOVOLTAIC/SOLAR THERMAL ELECTRIC POWER SYSTEM. VOLUME 2: STUDY RESULTS
Final Report
Jul. 1981 242 p Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-026737; SAND-80-7014/2-Vol-2) Avail: NTIS HC A11/MF A01

A hybrid photovoltaic/solar thermal electric conversion system is described. Several types of hybrid systems, photovoltaic only systems, and solar thermal electric systems were compared in performance and cost. It is found that hybrid systems potentially competitive with photovoltaic only or solar thermal electric conversion systems. However, hybrid systems do not appear to have a significant advantage on a levelized cost per kilowatt hour basis. DOE

N81-33652# Spectrolab, Inc., Sylmar, Calif.
CONCEPTUAL DESIGN AND SYSTEM-ANALYSIS STUDY FOR A HYBRID SOLAR PHOTOVOLTAIC/SOLAR THERMAL ELECTRIC POWER SYSTEM. VOLUME 1: EXECUTIVE SUMMARY
Jul. 1981 59 p Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-026162; SAND-80-7014/1-Vol-1) Avail: NTIS HC A04/MF A01

Studies on hybrid photovoltaic/solar thermal electric conversion systems are summarized. Several types of hybrid systems, photovoltaic only systems, and solar thermal electric systems were compared on performance and cost. Hybrid systems are shown to be competitive with photovoltaic only or solar thermal electric conversion systems, however, hybrid systems do not appear to have a significant advantage on a levelized cost per kilowatt hour basis. DOE

N81-33654# New Hampshire Univ., Durham. Dept. of Chemical Engineering.
CONTINUOUS TWO-STAGE SOLAR-GASIFICATION SYSTEM
V. K. Mathur, S. M. Lakshmanan, F. K. Manasse, V. Venkataramanan, and R. W. Breault 1980 20 p refs Presented at the AICHE 73rd Ann. Meeting, Chicago, 16-20 Nov. 1980 Submitted for publication
(Contract DE-AC02-79ET-21087)
(DE81-026019; CONF-801104-18) Avail: NTIS HC A02/MF A01

The use of solar thermal energy has the potential to play an important role in the production of fuels and chemicals. A continuous two stage fluidized bed hybrid solar coal gasification system designed at the University of New Hampshire to produce synthesis gas from various feed stocks - coal, lignite and peat

is discussed. Heat and material balance are presented. The experimental data obtained from this bench scale unit will be useful for the commercialization of this technology. Economics of commercial solar gasification plants weight reference to their size are discussed. A suitable capacity for a solar hybrid plant is estimated to be 1.46 x 10 to the 6th power cu cm (50 MM SCF) per day of SNG. DOE

N81-33658# Pacific Sun, Inc., Palo Alto, Calif.
OAKMEAD SOLAR BUILDINGS
Mar. 1981 161 p refs
(Contract DE-FC03-77CS-31521)
(DOE/CS-31521/T1) Avail: NTIS HC A08/MF A01

Twin 50,000 square feet industrial buildings, incorporating both active and passive solar design features, in the Oakmead Industrial Park, Santa Clara, California, employ slab floor construction and tilt-up concrete walls. A structural facia on the north extreme of each building provides a 45 deg support for approximately 2800 square feet of high-performance flat plate collectors. These liquid-based collectors form the basis for an active solar subsystem which includes a unique control logic to manage energy in a Second Law sense. The south-facing, vertical tilt-up concrete wall has been modified to accommodate some 1200 square feet of air-based collector fashioned after a Trombe design. The tilt-up wall fabrication technique is commonly used in commercial and industrial building construction, and shows promise for ready adaptation to passive solar heating applications. The combined active and passive subsystems were designed to provide approximately 90% of the annual energy requirements for heating and hot water. DOE

N81-33660# Schumacher (J. C.) Co., Oceanside, Calif.
LOW-COST-SILICON-PROCESS DEVELOPMENT, PHASE 4: PROCESS IMPROVEMENT Quarterly Technical Progress Report
R. V. Giraudi and C. G. Newman Apr. 1981 62 p refs
(Contract DE-AC02-77CH-00178)
(DE81-769623; SERI/PR-8279-1-T2; QTPR-2) Avail: NTIS HC A04/MF A01

During this period process improvement studies continued in the mini-plant, focusing on the correlation of current mini-plant yield results with prior laboratory scale work. Silicon bromination in the synthesis unit and tribromosilane purification in the distillation unit proceeded efficiently and without complication. Tribromosilane yields in the synthesis unit were low due to unobtainable higher reaction temperatures. Initial polycrystalline silicon production studies indicate consistent yields of 85%. The laboratory scale static bulk reactor system was calibrated by observing the decomposition of t-butyl chloride. A free space reactor apparatus was assembled and tribromosilane decompositions, as a function of dilution in argon, was studied. DOE

N81-33662# Kraftanlagen A.G., Heidelberg (West Germany).
DOMESTIC WATER HEATING BY SOLAR ENERGY Final Report
Friedrich Rennmuth Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 37 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-062; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8

A solar hot water plant was equipped with extensive measuring instrumentation. The main results of tests carried out during 1 year, are: the average collector efficiency during 1 year operation is 15.9%; the total collector area of 30 sqm (23 sqm oriented to the south-west and 7 sqm to the south-east) produces 3.9 MWhr useful heat in 12 months; the climatic data of the test year (Sun radiation and outside temperatures) approximately agree with multiyear average data from the German weather bureau); and the 30 sqm collector plant only supplies 16% of the total yearly heat demand of the new dwelling of 150 sqm useful area (for space and hot water heating). Author (ESA)

N81-33665# Metallgesellschaft, A.G., Frankfurt am Main (West Germany). Metall-Lab.
DEVELOPMENT OF COMPONENTS FOR THE SOLAR HEATING CIRCUIT Final Report
Manfred Moeller Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 84 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-154; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 17.65

An aluminum/manganese/zirconium alloy suitable for the roll-bond method was developed and a process for the manufacture of solar absorbers on the basis of this material is described. Correctly adjusted inhibited glycol-water mixtures and synthetic heat transfer fluids proved their value for solar installations with aluminum components. The pH-value and the efficiency of the inhibitors of glycol-water mixtures must be regularly controlled. If synthetic heat transfer fluids are used, care should be taken that they, and also the installation, are free from water in order to avoid corrosion damage. With the present status of technology, water to which inhibitors or inhibitor mixtures are added, is not suited for this purpose. Author (ESA)

N81-33666# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany). Neue Technologie.
QUALIFICATION OF THE M. A. N. SOLAR FARM MODULE TYPE 3/32 AS PART OF A DEMONSTRATION PROGRAM Final Report
Karl Wildenrotter Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 46 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-162; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9

The structure, the collectors, the driving and piping systems were optimized. A special electronic tracking system was developed. Critical components were tested and qualified. Mechanical and thermal tests of the complete module were conducted. The applicability of alternative mirror elements was studied. Improvements in the construction allow for higher efficiency and a reduction in production costs of 17%. The installed driving power was reduced from 430 to 203 W and the module weight from 2500 to 1900 kg. Author (ESA)

N81-33672# Thermo Electron Corp., Waltham, Mass.
THE DEVELOPMENT OF SOLAR-ASSISTED GAS-FIRED APPLIANCES Final Report, Phase 1
Kenneth G. Hagen 12 Sep. 1980 161 p refs
(Contract GRI-5014-343-0189)
(PB81-217606; TE-4274-69-81; GRI-79/0098) Avail: NTIS HC A08/MF A01 CSCL 10A

The application of solar assistance to gas-fired appliances other than space and water heating systems was accomplished for the residential and commercial sectors. This included an assessment of the energy use characteristics of residential and commercial appliances and the relationship to solar availability. Selected applications indicate a higher likelihood of early commercial viability than can be expected with active solar space heating and cooling systems. High solar utilization and system simplicity can be combined with certain appliance applications. GRA

N81-33673# Illinois Inst. of Natural Resources, Springfield. Resources Development Div.
PROJECT SUMMARIES OF THE ILLINOIS LOW-COST SOLAR ENERGY DEMONSTRATION GRANT PROGRAM 1980
Allen Elrod Jul. 1980 26 p
(PB81-210577; ILLDOE-80/21) Avail: NTIS HC A03/MF A01 CSCL 13A

Funding for each project is part of the grant program conducted by the Illinois Institute of Natural Resources. Local governments and community organizations trained local labor in low-cost solar technology and built either a solar greenhouse, vertical wall collectors, or window box collectors as demonstration projects to low-income neighborhoods. The report highlights each project and provides contact persons for further details. GRA

03
HYDROGEN

Includes hydrogen production, storage, and distribution.

A81-42589 **Proposal for a possible use of fusion power for hydrogen production within this century.** W. Seifritz (Zürich, Eidgenössische Technische Hochschule, Würenlingen, Switzerland). *International Journal of Hydrogen Energy*, vol. 6, no. 4, 1981, p. 331-338. 16 refs.

Consideration is given to the possibility of building a commercial fusion power reactor before the turn of the century. The main element incorporated by the proposed system is the PACER project powerplant, which employs the explosive deuterium-deuterium (D-D) fusion process. Because all required technology already exists, PACER is believed to represent the quickest way to harness fusion on a large scale. It is argued that such reactors, scattered throughout the world on a series of 'energy parks', will meet a 30 TW global energy demand after the depletion of fossil fuel resources. Consideration is also given to both the breeding of fissile materials and the electrolytic production of hydrogen; a by-product of which would be deuterium fuel. O.C.

A81-42590 **Solar synthetic fuel production.** E. Bilgen (Ecole Polytechnique; Exergy Research Corp., Montreal, Canada) and C. Bilgen (Exergy Research Corp., Montreal, Canada). *International Journal of Hydrogen Energy*, vol. 6, no. 4, 1981, p. 349-362. 12 refs. Department of Supply and Services Contracts No. 11SQ-31025-7-1509-5; No. 08SX-31155-8-6602.

In this paper, a thermodynamic study is presented on solar hydrogen production using concentrated solar energy. In the first part, the direct decomposition process has been studied. The temperature requirements at various partial pressures of H2O, H2 and H yields, thermal efficiency and separation of products are discussed. In the second part, using consistent costing bases, the cost of hydrogen is estimated for solar-direct decomposition process and solar-electrolysis process. It has been found that the solar-direct decomposition process concept provides hydrogen costs in the range of $22/GJ which are lower by $15-$26 than those provided by a solar electrolysis process. (Author)

A81-42592 **Hydrogen combustion test in a small gas turbine.** M. Nomura, H. Tamaki, T. Morishita, H. Ikeda, and K. Hatori (Ministry of Transport, Ship Research Institute, Mitaka, Tokyo, Japan). *International Journal of Hydrogen Energy*, vol. 6, no. 4, 1981, p. 397-412.

Details of the gaseous hydrogen combustion test in a can-type conventional gas-turbine combustor and the operating performance of a 275 PS (202 kW) small gas turbine are provided. Initially, experiments were conducted to determine the configuration of the hydrogen fuel nozzles on a combustor test facility. The kerosene fueled gas turbine combustor was used without modification of the original configuration and dimensions. Secondly, the operation performance of the gas turbine was investigated when the gaseous hydrogen was used as a substitute fuel for kerosene fuel. The kerosene fuel supply system was removed or rendered inoperative and a hydrogen flow metering system was newly installed. The high pressure storage cylinders were used to supply hydrogen to the fuel metering system. Data was obtained on pressure losses of the fuel nozzles, ignition performance, temperature distributions at the combustor outlet, combustion efficiency, liner wall temperature distributions, NOx emission levels, noise levels, operating performance, etc. (Author)

A81-42853 **Improvements leading to high efficiency alkaline electrolysis cells.** J. N. Murray and M. R. Yaffe (Teledyne, Inc., Teledyne Energy Systems, Timonium, MD). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 15-27. 9 refs. Research sponsored by the U.S. Department of Energy.

Recent progress in the improvement of the operating efficiency of alkaline water electrolysis cells for hydrogen production is discussed. Development efforts have been concentrated on the replacement of the conventional asbestos electrode separator by a porous electrode separator fabricated from polybenzimidazole, advanced electrode screening modules, extended duration tests of the improved electrocatalyst/electrode systems, and an engineering design and economics evaluation computer program designed to calculate the cost of hydrogen and the design of the cost-optimal electrolysis plant. The improvements undertaken thus far have resulted in an increase in cell voltage efficiency from less than 71% to 86% by the use of a new high-efficiency cathode structure and operation at higher temperatures and reasonably high current densities. A.L.W.

A81-42854 **Hydrogen production by high temperature, high pressure water electrolysis. I - Plant development.** I. Abe (Electric Power Development Co., Ltd., Tokyo, Japan), T. Fujimaki (Showa Denko, General Technical Research Laboratory, Japan), Y. Kajiwara (Hitachi Shipbuilding and Engineering Co., Ltd., Nuclear Engineering Dept., Tokyo, Japan), and Y. Yokoo (Mitsubishi Kakoki Kaisha, Research Dept., Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 29-41.

The development of a test plant with a hydrogen-production capacity of 4 cu Nm/hour based on a high-temperature, high-pressure water electrolyzer is discussed, and results of corrosion tests on metallic materials for plant construction are presented. The test plant electrolyzer was designed and constructed on the basis of the construction and testing of a series of bench-scale electrolyzers operating at atmospheric pressure with single and bipolar cell capacities from 20 to 300 l/hr. The test plant, in turn, is intended to be used to provide data for the design of a 20-cu Nm/hour pilot plant in the areas of cell structures, electrode and diaphragm evaluation, energy efficiency and the gas-liquid separator and control system. In order to select materials for the pilot plant, corrosion and stress corrosion cracking tests were performed on various stainless steels and higher nickel alloys in 30 wt % KOH at 130 and 150 C in O2 and Ar atmospheres. Results of the tests have shown type 310 ELC austenitic stainless steel to be sufficiently resistant for use at operating temperatures up to 150 C, at which no corrosion is observed. A.L.W.

A81-42855 **Hydrogen production by high temperature, high pressure water electrolysis. III - Design and construction of test plant.** Y. Kajiwara, S. Maezawa (Hitachi Shipbuilding and Engineering Co., Ltd., Nuclear Engineering Dept., Tokyo, Japan), and K. Matsunaga (Hitachi Shipbuilding and Engineering Co., Ltd., Plant Design Dept., Osaka, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 43-47.

The design and construction of a test plant of hydrogen capacity 4 cu Nm/hour based on high-temperature, high-pressure water electrolysis which was built to obtain technical data for the construction of a 20-cu Nm/hour pilot plant are outlined. The test plant is a forced circulation system comprised of an electrolyzer, electrolyte circulation line, gas-liquid separator, hydrogen/oxygen production gas line, measurement and control equipment, power conditioning equipment, and auxiliary equipment. The plant is designed to operate using a KOH electrolyte at 20 kg/sq cm pressure and 120 C temperature, and incorporates various safety features for operation monitoring, emergency shutdown and personnel protection. Principle construction materials were selected with a view towards corrosion resistance. Based on preliminary design studies, controlling methods and plant construction were selected to optimize the pressure load oscillation at the separator, and the separator was configured to optimize the void mixing rate. A.L.W.

A81-42856 **Specifications and measurements of alternative diaphragms for the industrial advanced alkaline electrolysis.** J. C. Bardin (Gaz de France, Paris, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.
Oxford and New York, Pergamon Press, 1981, p. 49-57.

Increasing the operating temperature of an alkaline electrolysis

cell to improve cell efficiency leads to a requirement for replacing the asbestos diaphragm used in conventional cells with new separator materials. The present paper discusses means for the evaluation of alternative material performance and formulates a set of specifications for diaphragm characteristics. The measurements to be made are in the areas of sample porosity, mechanical behavior, and wettability, with final selection to be on the basis of tests of the operating characteristics of a water electrolysis monocell at a temperature of 120 to 200 C, pressure of 60 bar, current density of 1 A/sq cm and active surface of 0.2 x 0.5 m. A.L.W.

A81-42857 Advanced alkaline water electrolysis. N. Wakabayashi, E. Torikai, Y. Kawami, and H. Takenaka (Osaka, Government Industrial Research Institute, Ikeda, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 59-72. 6 refs.

Results are presented of experimental studies of possible separators and electrodes for use in advanced, high-temperature, high-pressure alkaline water electrolyzers. Material evaluations in alkaline water electrolyzers at temperatures from 100 to 120 C have shown a new type polytetrafluoroethylene membrane impregnated with potassium titanate to be the most promising when the separator is prepared by the hydrothermal treatment of a porous PFTE membrane impregnated with hydrated titanium oxide. Measurements of cell voltages in 30% KOH at current densities from 5 to 100 A/sq dm at temperatures up to 120 C with nickel electrodes of various structures have shown the foamed nickel electrode, with an average pore size of 1-1.5 mm, to have the best performance. When the foamed nickel is coated by fine powdered nickel, carbonyl nickel or Raney nickel to increase electrode surface areas, even lower cell voltages were found, indicating better performance. A.L.W.

A81-42858 Development and operation of a hybrid acid-alkaline advanced water electrolysis cell. O. Teschke and M. Zwanziger (Campinas, Universidade Estadual, Campinas, Brazil). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 73-79. Financiadora de Estudos e Projetos Contracts No. IF/791; No. B/264.

A hybrid acid-alkaline water electrolysis cell has been developed for hydrogen production. The cell is based on the use of an acidic solution at the cathode and a basic solution at the anode to reduce the minimum theoretical voltage for water decomposition from the thermoneutral potential of 1.47 V to close to 1.4 V at 25 C and 1 atm. The pH differential is maintained by the removal of OH ions from the cathode section and water removal from the anode section, which can be driven by heat energy. A practical cell has been built using a solid polymer electrolyte in which, however, the cathodic compartment is not acidic but neutral. Tests with a platinum black cathode catalyst and a platinum-iridium anode catalyst have resulted in steady-state water hydrolysis at an applied voltage of 0.9 V, and a V-I diagram with a considerably lower slope than that of a conventional cell has been obtained at 90 C. A.L.W.

A81-42859 Advanced water alkaline electrolysis - A two years running of a test plant: 120 C - 160 C, 20 bars /about 300 p.s.i./. C. Bailleux (Electricité de France, Saint-Denis, Seine-Saint-Denis, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 81-98.

Results acquired in the two-year operation of an advanced pressurized forced-flow alkaline water electrolysis test plant are reported. The test loop consists of eight monopolar cells, circulator, filter units and heat exchangers designed to operate with a 40 wt percent KOH electrolyte at a temperature between 120 and 160 C, a pressure of 20 bars, a current density of 10 kA/sq M and input electric power of 1.75 W. Each cell is made up of two shells of 290 mm external diameter and thickness 40 mm on either side of an FEP-coated diaphragm with a working area of 120 x 120 mm. During the two years of operation, the duty factor for temperature operation has increased from 44 percent to more than 80 percent and that for electrolysis operation has increased from 27 percent to 60 percent, with continuous steady state operation for as long as 35 days. Tests have confirmed the stability of a chrysotile asbestos diaphragm when the electrolyte is doped with silica ions, and revealed deteriorations in materials stability due to gasket creep and metal corrosion. The behavior of the nickel electrodes was observed to be influenced by operating temperatures, cathodic deposits, electrode structure and thermal treatment. In spite of the careful design of the gravity separating tanks, purity of the produced O2 was found unsatisfactory, although no trouble arose on the hydrogen side. Results of the operation of the test loop have been scaled up in order to predict the performance of a large-scale pilot plant. A.L.W.

A81-42860 Obtention and evaluation of polyethylene-based solid polymer electrolyte membranes fro hydrogen production. J. P. Masson, R. Molina, E. Roth (Commissariat à l'Energie Atomique, Fontenay-aux-Roses, Hauts-de-Seine, France), G. Geussens, and F. Lemaire (Commissariat à l'Energie Atomique, Office des Rayonnements Ionisants, Saclay, Essonne, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 99-105. 13 refs. Research supported by the Commissariat à l'Energie Atomique; Délégation Générale à la Recherche Scientifique et Technique Contracts No. 77-7-1214; No. 79-7-0219.

The fabrication and testing of a polyethylene-based solid polymer electrolyte for use in hydrogen production by water electrolysis are discussed. The fabrication process involves the radiation grafting of styrene groups onto a polyethylene matrix, followed by the chemical sulphonation of the resulting polymer. The membrane produced has exhibited resistivities as low as 60 ohm cm for a 1-mm thickness, and other properties of the same order of magnitude as those of the commercially available but more expensive Nafion 014 membrane. Life tests carried out at a current density of 2 kA/sq m in single-cell modules with 10-sq cm active surface have revealed no noticeable degradation in membrane mechanical or electrical properties after 3000 hours for membranes reinforced by an organic polymer fabric. The development of an electrolyzer specifically designed for operation with a solid polymer electrolyte is currently under way. A.L.W.

A81-42861 Solid polymer electrolyte water electrolysis. H. Takenaka, E. Torikai, Y. Kawami, and N. Wakabayashi (Osaka, Government Industrial Research Institute, Ikeda, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 107-117. 8 refs.

Electrocatalyst performances and bonding to solid polymer electrolytes used for water electrolysis are investigated. Noble metal and metal alloy catalysts were plated to Nafion perfluorosulfonic acid polymer membranes without a binder by the use of a reducing agent solution held on the opposite side of the membrane from a metal salt solution. It was found that pretreatment of the membrane by hydrothermal treatment or gas plasma surface roughening improves metal adhesivity and thus reduces contact resistance between the membrane and the catalyst. Measurements of the constituents of cell voltage for platinum, rhodium and iridium anodes with platinum cathodes reveals that anodic overvoltage is a major component of voltage loss and depends on the type of electrocatalyst, being greatest for Pd and least for Ir. Ir and Ir-alloy electrodes, which were found to be the best catalysts for oxygen evolution, are found to have Tafel slopes of 0.04-0.06 V/decade. In a cell with a Pt cathode and Ir anode, cell voltage is observed to decrease with increasing temperature, reaching 1.56-1.59 V at a current density of 50 A/sq dm and 90 C, which corresponds to a thermal efficiency of 93-95%. A.L.W.

A81-42863 On the electrochemical behaviour of traditional materials for the production of hydrogen by electrolysis. L. A. Avaca, A. Carubelli, and E. R. González (São Paulo, Universidade, São Carlos, Brazil). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 127-134. 5 refs. Research supported by the Financiadora de Estudos e Projetos.

The relevance of relatively fast electrochemical measurements to the behavior of electrode materials subjected to prolonged operation

is evaluated as it relates to electrode materials for tank-type water electrolyzers. Polarization curves for the hydrogen and oxygen evolution reactions were recorded for cathodes of electrodeposited iron, nickel, tungsten and nickel-cobalt alloy and anodes electrodeposited nickel and nickel-cobalt alloy on mild steel plates in 28 percent KOH solution; variations of electrode potentials and cell voltage with time at a constant current density were also measured. Tafel plots obtained from the polarization curves are shown to differ from the steady potentials obtained after continuous operation for over 30 hours. Results are attributed to the pretreatments of the electrodes and solution necessary to obtain reproducible results in the kinetic experiments. A.L.W.

A81-42864 Electrolytic hydrogen production at packed bed electrode. Z. D. Stankovic (Beograd, Univerzitet, Bar, Yugoslavia). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 135-150. 18 refs.

Results are presented of the experimental production of electrolytic hydrogen at a packed bed electrode. Electrolysis was carried out in a two-compartment cell with a packed bed of spherical copper, nickel, pyrite, silver-coated glass or carbon-coated glass particles as the cathode and a platinum spiral anode in solutions of 5, 10, 20 and 30 wt % KOH and 20 wt % NaOH, KCl, H2SO4 and HCl. Measurements of the open-circuit potential and overpotential reveal only the bed of copper spheres to have an overpotential less than that of the platinum cathodic feeder. A lower overpotential was obtained in the KOH solutions, with a minimum at a concentration of 20 wt %. Particle volume as well as surface area are also observed to influence the overpotentials recorded, while electrolyte flow is found to increase the electrode potential for hydrogen reduction and increases in temperature decrease the potential. Results obtained thus demonstrate the feasibility of applying packed bed electrodes for electrolytic hydrogen production. A.L.W.

A81-42865 Low overvoltage electrocatalysts for hydrogen evolving electrodes. D. E. Brown, M. N. Mahmood, A. K. Turner, S. M. Hall, and P. O. Fogarty (British Petroleum Co., Ltd., Research Centre, Sunbury-on-Thames, Middx., England). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 151-163. 33 refs.

The performance of a transition-metal-based electrocatalyst for hydrogen-evolving cathodes is reported. Initial performance tests conducted at a temperature of 70 C in a 30% KOH electrolyte show overpotentials in the range of 70 to 90 mV at a current density of 1 A/sq cm, with only a small rise in overpotential with increasing current density. Results of long-term testing indicate the absence of any appreciable time variation in electrode overpotential for over 1000 hours, and the stability of the electrocatalyst coating to current interruption and reversal. A.L.W.

A81-42866 Electrocatalysis in the oxygen evolution. G. Fiori and C. M. Mari (Milano, Università, Milan, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 165-174. 18 refs. Research supported by the Commission of the European Communities.

The electrocatalytic properties of mixed nickel lanthanum oxides in the oxygen evolution reaction are examined. Catalytic films were deposited on bulk nickel substrates by the thermal decomposition of various mixtures of unstable salts of nickel, lanthanum, lithium, magnesium, iron and cobalt, and quasi-steady polarization curves and potential time curves at high and constant current densities were determined. The greatest electrocatalytic activity is observed for a nonstoichiometric oxide of formula Ni(0.2)Co(0.8)LaO3. It is also found that deposition by spraying the solution on the hot metallic surface is quicker and provides results as good as painting followed by thermal decomposition. A review of the pertinent literature studies concerning oxygen evolution reaction catalysts is presented which confirms the effectiveness of Ni and Co as anode catalysts. The probable role of La and the lack of stoichiometry in stabilizing the oxide is also indicated. A.L.W.

A81-42870 Hydrogen production by the GA sulfur-iodine process - A progress report. G. E. Rosenbruch, K. H. McCorkel, J. H. Norman, D. R. O'Keefe, J. R. Schuster (General Atomic Co., San Diego, CA), and M. Yoshimoto (Idemitsu Kosan Co., Ltd., Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 243-256.

Progress made over a two-year period on a sulfur-iodine thermochemical water-splitting cycle is summarized. The major accomplishments are listed, among which are significant improvements in the chemistry of the process and the development of a conceptual, preliminary flow sheet for a sulfur-iodine cycle driven by solar energy. The results of the work carried out thus far are considered to demonstrate that thermochemical water splitting by the sulfur-iodine cycle is a feasible process and that thermal efficiencies in the range of 50% are attainable. The four areas into which the total process development has been divided - basic chemical investigations, material investigations, process engineering studies, and bench-scale testing - are discussed. It is concluded that the process will be shown to be a viable, economic alternative for hydrogen production. C.R.

A81-42872 The liquid hydrogen iodide decomposition process step for water-splitting applications. D. R. O'Keefe and J. H. Norman (General Atomic Co., San Diego, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.

Oxford and New York, Pergamon Press, 1981, p. 277-295. Research supported by the Gas Research Institute and General Atomic Co.

The reported studies are concerned with the optimization of the sulfur-iodine cycle used to obtain hydrogen from water. According to this cycle, sulfur dioxide reacts with iodine and water to form sulfuric acid and hydrogen iodide. Hydrogen and iodine are obtained as a result of the decomposition of HI. The homogeneous decomposition of HI could be used directly in a thermochemical process to split water. However, the temperature required would be relatively high. Catalyst utilization allows substantial temperature reduction for the same conversion rate. The decomposition of liquid HI is studied as another approach for enhancing HI conversion. A process step for liquid HI decomposition employing HI-I2 distillation is considered along with a process step for liquid HI decomposition employing I2 precipitation. The theoretical investigations were supplemented by precursory experimental studies to establish more fully the engineering viability of liquid HI decomposition. G.R.

A81-42875 Interfacing primary heat sources and cycles for thermochemical hydrogen production. M. G. Bowman (California, University, Los Alamos, NM). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 335-344. 13 refs.

It is pointed out that an efficient utilization of heat from high-temperature heat sources in processes, which employ thermochemical cycles to obtain hydrogen from water, can be achieved only if the reaction temperatures and heat requirements of the cycle match the maximum temperature and heat delivery characteristics of the heat source. An investigation is, therefore, conducted regarding the criteria for ideal cycles in terms of their potential for practical adaptation to available heat sources. Attention is given to a method for selecting cycles for specific maximum temperatures in terms of thermodynamic criteria for 'ideal' cycles, the heat source characteristics, the direct decomposition of H2O and CO2, oxide decomposition cycles, sulfuric acid - metal sulfate cycles, alternate sulfate cycles, and low temperature cycles. G.R.

A81-42876 The LASL bismuth sulfate thermochemical hydrogen cycle. K. E. Cox, W. M. Jones, and C. L. Peterson (California, University, Los Alamos, NM). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1.

Oxford and New York, Pergamon Press, 1981, p. 345-364. 16 refs.

The development of cycles based on solid sulfate decomposition is considered, taking into account three cycles which have been

selected for extensive development. These cycles include the hybrid sulfur cycle, the sulfur-iodine cycle, and a sulfur-bromine cycle (Mark 13 cycle). Criteria used in the selection of these cycles include the use of an all-liquid or gas system, a maximum cycle temperature in the 1100 K range, and in two cases, the hybrid cycle and the Mark 13 cycle, the use of an electrochemical step for the low temperature hydrogen-producing reaction. All these cycles include evaporation of aqueous sulfuric acid solution, decomposition of sulfuric acid to water and sulfur trioxide followed by decomposition of sulfur trioxide to sulfur dioxide and oxygen as common steps. Attention is given to the choice of the metal sulfate system, the bismuth sulfate cycle, the solids decomposition facility, bismuth sulfate morphology, and aspects of process design. The bismuth sulfate cycle is found to be the most promising choice from the considered sulfate cycles.

G.R.

A81-42878 Thermochemical hydrogen production by SO2-CH3OH-I2 cycle. M. Dokiya, M. Fujishige, T. Kameyama, K. Fukuda, and H. Yokokawa (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 373-387. 13 refs.

Using the reaction 2CH3OH + I2 + SO2 + aq = 2CH3I + H2SO4 (aq), a family of CH3I cycles is designed and experimentally proved to be feasible. Assuming a process flow sheet and using industrial data, the probable thermal efficiency and cost of hydrogen are estimated. It is thought that the thermal efficiency and cost expected in the CH3I cycle will be nearly the same as in the water electrolysis process. The rather low thermal efficiency is seen as a result of the fact that 2 moles of methanol are circulating to produce 1 mole of hydrogen. A more efficient cycle will therefore be established when the amount of methanol can be reduced to 1 mole/H2. It is pointed out that some experimental results suggest that such a cycle is possible.

C.R.

A81-42880 Recovery of hydrogen from hydrogen sulfide with metals or metal sulfides. H. Kiuchi, I. Nakamura, K. Funaki, and T. Tanaka (Hokkaido University, Sapporo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 401-411. 10 refs.

Two types of reactions for the recovery of hydrogen from hydrogen sulfide using metals or metal sulfides are investigated. The first type of reaction, which involved the sulfurization of metals or metal sulfides with H2S and the thermal decomposition of the products into hydrogen, elemental sulfur and the original metals or metal sulfide, was studied by the measurement of H2 evolution in a packed bed of powders of Ag, FeS, Co9S8, Ni3S2 and various sulfide mixtures. The second type of reaction involves the sulfurization of a metal by H2S and the recovery of the metal by the oxidation of the metal sulfides formed, and was studied for the case of molten lead, molten lead with the addition of Ni or Co, Ag, Cu and Ni powders, and molten Ag-Bi alloy. Extents of reaction and temperature dependence were determined for each step of the reactions, and the repeatability of the cycles was examined.

A.L.W.

A81-42882 Development status of electrolysis technology for the sulfur cycle hydrogen production process. P. W. T. Lu and R. L. Ammon (Westinghouse Electric Corp., Pittsburgh, PA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 439-461. 25 refs.

The Sulfur Cycle Hydrogen Production Process comprises an electrochemical and a thermochemical reaction. In an electrolysis cell, sulfur dioxide dissolved in aqueous solutions is electrochemically oxidized to sulfuric acid at the anode, while hydrogen gas is evolved at the cathode. By use of thermal energy from a high-temperature heat source, sulfuric acid produced in the electrolyzer is vaporized and catalytically decomposed to form sulfur dioxide, water and oxygen. Four approaches for improving electrolysis technology are considered, including an electrochemical study of catalysts, the development of electrode fabrication processes, the optimization of cell configuration, and the selection and investigation of separator materials. Palladium and palladium oxide were found to be superior to platinum as electrocatalysts for SO2 oxidation.

G.R.

A81-42883 Processes for combined production of hydrogen and other chemical products without using fossil fuels. G. H. Schütz (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 463-475. 11 refs.

The advantages and disadvantages of the combined production of hydrogen and other chemical products are discussed. Potential feedstocks in addition to water are examined. Aside from fossil fuels, the most attractive hydrogen-producing system is found to be that using sulfur compounds and water. This system permits substantial quantities of hydrogen to be produced together with various amounts of sulfuric acid, ammonium sulfate, or calcium sulfate. The way in which the output of the by-product can be reduced with the aid of new processes is described. It is noted that hydrogen produced by such processes could be much cheaper than hydrogen from water electrolysis.

C.R.

A81-42885 Development of the Li-H cycle. F. Behr, F. Flocke, R. Schulten, H. Süssmann, and W. Weirich (Aachen, Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 489-501. 20 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4133-A.

The first experiments with new hybrid family cycles that work with a metallic membrane permeable only to hydrogen in an atomic or protonic shape are discussed. The voltage of the electrochemical step is lowered by alkali and/or alkaline-earth metals on the back side of the cathode, which simultaneously acts as a membrane. The Li-H cycle shows that, as a result of the high electrolysis temperature, only very low losses of reversible work occur, that high current densities are attainable, and that no noble metals need be used for the electrodes.

C.R.

A81-42887 Process for the concurrent production of hydrogen, carbon monoxide and low-volatile, low-sulfur char by flash carbonization of coal. R. L. Savage, W. J. Chen, N. G. Patke, J. Y. Tong (Ohio University, Athens, OH), A. Sato (Chubu Institute, Kasugai, Nagoya, Japan), M. Hereth (Centec Consultants, Inc., Reston, VA), and W. E. Kneller (Toledo, University, Toledo, OH). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 519-536. 15 refs. Research supported by the Ohio Department of Energy, Ohio Air Quality Development Authority, and U.S. Department of the Interior.

Flash carbonization to produce hydrogen and carbon monoxide with the concurrent production of low-sulfur, low-volatile char from bituminous coal is investigated. High temperatures (more than 1255 K) and short reaction times (less than 5 sec) are used at pressures ranging from 1 to 35 atm. No tar is formed in the process, and the gas is separated immediately from the hot char, which is quenched to retain a volatile content of approximately 10-20%. Results of thermodynamic equilibrium calculations using the free energy minimization method and the equilibrium constant method are found to be in good agreement and are compared with experimental results. It is noted that predesign capital and operating cost estimates indicate that the cost of producing synthesis gas (hydrogen and carbon monoxide) by this process would be competitive with the cost of producing synthesis gas by the partial oxidation of methane when the by-product char is credited at the fuel equivalent value.

(Author)

A81-42889 Production of hydrogen from hydrogen sulfide by means of selective diffusion membranes. T. Kameyama, K. Fukuda, M. Fujishige, H. Yokokawa, and M. Dokiya (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen

Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 569-579. 10 refs.

The possibility of the use of microporous ceramic membranes for the effective production of hydrogen on the catalytic decomposition of hydrogen sulfide was examined. Both a microporous Vycor type glass membrane having a mean pore diameter of 45 A and a new microporous alumina membrane having a mean pore diameter of 1000 A were able to use as separation membranes for the H2 - H2S separation system; the former was stable up to 800 C and the latter up to higher temperatures. A new microporous alumina membrane has higher permeability than a microporous Vycor type glass membrane by about 50 times. The use of these membranes at the decomposition temperature of hydrogen sulfide has increased the yield of hydrogen continuously by about two times of equilibrium one. (Author)

A81-42891 Studies on ferric oxide electrodes for the photo-assisted electrolysis of water. M. V. C. Sastri and G. Nagubramanian (Indian Institute of Technology, Madras, India). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 597-607. 9 refs. Ministry of Industrial Development Grant No. SPD/46(24)/74.

A81-42892 Photoassisted electrolysis of water by Si photoelectrodes. M. Noda (Aichi University of Education, Kariya, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 609-620. 15 refs.

The photoelectrolysis of water in NaOH and NaCl electrolytes, using Si semiconductor photoelectrodes, is presented. External bias voltage (V sub b) is applied between the p-type Si cathode and the Pt anode. If V sub b is absent, the potential of the Si electrode (V sub e) and the short circuit current between Si and Pt electrodes are increased by the illumination, which dissolves the Si surface. When V sub e exceeds the value of approximately 11.5 V, the photocurrent is greatly increased. Results of the study show a decomposition voltage of 1.4 V for 0.1 M NaOH, and less than approximately 1.9 V for 0.1 M NaCl, indicating a greater power conversion efficiency for the first case. Using illumination of 161 mW/sq cm and 82 mW/sq cm, maximum efficiencies of approximately 13.4 and 16.6%, respectively, are reported. An SnO2 coated silicon electrode can be used as a stable anode; its threshold potential is smaller than that of the uncoated sample, but the photocurrent saturates at a higher current value. K.S.

A81-42893 Photoassisted decomposition of water over doped rutile electrodes. N. Giordano, V. Antonucci, S. Cavallaro, R. Lembo (Messina, Università, Messina, Italy), and J. C. J. Bart (Montedison S.p.A., Novara, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 621-630. 37 refs. Research supported by the Consiglio Nazionale delle Ricerche.

The photoelectrolysis of water on a series of doped TiO2 semiconductors is presented. The TiO2 electrodes are prepared from 1 mm thick laminae of titanium, oxidized in an oven at 700 C for 4 h, and repeatedly impregnated in aqueous or acid (HCL) solutions containing equimolar (1M) quantities of TiCl3 and nitrates (or chlorides) of the dopant metal. The electrode current-voltage characteristics are measured in a one-compartment cell, using a 1 m Na 2SO4 solution. A 400 W medium pressure mercury lamp, emitting in the 310 to 1000 nm range, is used as a light source. Cell potentials are measured with an electrometer. An expression is derivod for the energy conversion efficiency, which is strongly influenced by the preparation procedure. Pt-doping has the most marked positive influence and results in an energy conversion of 2.8 percent at 1 sun concentration, vs. 0.5 percent for an undoped sample. It is suggested that the best dopants, such as Pt, act through a reduction of the surface, thereby decreasing its acidity and increasing n-typeness. K.S.

A81-42894 Hydrogen production by hybrid electrolysis combined with assistance of solar energy. Z. Takehara and S. Yoshizawa (Kyoto University, Kyoto, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 631-640.

As a means of reducing the electrical energy needed to produce hydrogen from water, a process is presented, whereby an aqueous sulfuric acid solution containing Fe(2+) ions is electrolyzed, hydrogen being an energy storage material which levels load variation of electrical utilities. In an electrolytic cell, Fe(2+) ions are oxidized on a packed bed carbon anode to form Fe(3+) ions. H(+) ions diffuse through a cation exchange membrane, and are then reduced to hydrogen gas on the cathode. The Fe(3+) ions, produced in the cell, are decomposed in a photodecomposition cell. Oxygen evolves on the TiO2 anode, illuminated by solar light; the produced H(+) ions are diffused through a cation exchange membrane and electrons move through the metal inserted in the membrane to the cathode. The solution containing Fe(+) ions, introduced in the cathode chamber, is reduced cathodically on the platinized platinum. Cell voltage is determined for the process and it is found to be only about 1.0 V for electrolysis of 50mA/sq cm at room temperature. For the case of direct electrolysis of 2N NaOH aqueous solution, the cell voltage is 2.2V electrolysis of 30mA/sq cm. Results indicate a large reduction of electrical energy needed for the production of hydrogen in the process presented. K.S.

A81-42895 Energy conversion efficiency of high dense photochemical system of Fe-I. T. Ohta, N. Kamiya, Y. Fujita, N. Kikuchi, and H. Nambu (Yokohama National University, Yokohama, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 641-651.

An Fe-I hydrogen producing system, utilizing a photochemical hybrid reaction, is presented. An expression is given for the first reaction of the cycle, and using the steady state method, an expression for the stored free energy is derived. The apparatus for the photochemical analysis is described. A concave mirror and a Fresnel lens, collecting the light on the photochemical chamber, are used for the high intensity experiments. Xenon lamps are used as a light source, and the varied intensity of light is 1-12 times greater than that of solar radiation. A photochemical energy conversion efficiency of approximately 15-20% is obtained. Temperature dependence of the forward and the backward rate of reaction is studied, as is the relationship between the rate of the photochemical reaction and the iodine concentration. It is shown that the photochemical energy conversion efficiency increases with an increase of the light intensity. K.S.

A81-42896 A photoelectrochemical-thermal hydrogen producing cycle involving a semiconductor liquid junction cell. W. Gissler (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 653-661. 22 refs.

A photoelectrochemical-thermal hydrogen producing cycle is proposed involving a semiconductor liquid junction solar cell. In contrast with direct photoelectrolysis, the proposal is based upon a photoelectrochemical oxidation or reduction of the n- or p-type semiconductor electrode respectively in an aqueous electrolyte. In subsequent thermal reaction steps the water splitting process is completed, and the semiconductor electrode is regenerated. The advantage of the method is that semiconductors of band gap energies which are well matched to the solar spectrum can be used and correspondingly high solar energy conversion efficiencies can be obtained. The drawback is that the electrode regeneration process is in general quite complicated. The method is demonstrated by using a trigonal selenium electrode which allows a relatively simple regeneration. First experimental results on the photoelectrochemical reaction step are reported. (Author)

A81-42897 A novel photo-galvanic cell using anthraquinone-2-sulfonate. A. Roy and S. Aditya (University College of Science and Technology, Calcutta, India). In: Hydrogen energy

progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 663-670. 14 refs. Research supported by the Council of Scientific and Industrial Research of India.

A photochemical cell (PEC), based on the photochemistry of anthraquinone-2-sulfonate (D), is presented. In the presence of a formate, D(-) or D(2-) are produced from D, upon being illuminated, at a ph of 11.0. In the absence of oxygen, at the platinum electrode, the anodic reaction is D(-) resulting in D + e, or D(2-) resulting in D + 2e; and at the dark electrode, the cathodic reaction is O2 + 2H2O + 4e resulting in 4OH. Experimental results include the following: The cell's open circuit potential is 500 mV, and the open circuit potential is 180 microamps. Efficiency increases with platinized platinum electrode in the dark chamber, and it is improved even more with a CdS electrode in the illuminated chamber. A steady current of 120 microamps can be drawn upon illuminating it for 8 hours. The maximum power output is 4.2 x 10 to the -6th Watt. The advantage of the PEC cell is that the photochemical reaction does not show any back reaction, thereby imparting storage capability to the cell. K.S.

A81-42899 Experimental studies on direct thermal splitting of water. S. Ihara (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 685-692. 10 refs.

Experiments and preliminary results are presented on hydrogen separation from dissociated water vapor. A brief description of the experimental apparatus is presented. The beam sources are two xenon arc lamps, with an electrical input of 6.5 kW each, simulating solar energy utilization. Water vapor is heated on a protected tantalum disk, heated to about 2000 K. The resulting gas mixture is pumped up through a condenser and stored in a gas holder. Results of a gas-chromatographic analysis of the gas mixture are presented. K.S.

A81-42900 Potentiality of carbon dioxide radiolysis for hydrogen production. Y. Ikezoe, S. Sato, S. Shimizu, and H. Nakajima (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 693-703. 16 refs.

Carbon dioxide radiolysis was investigated theoretically and experimentally, and its potentiality for hydrogen production was examined. Elementary processes in the physical, physicochemical, and chemical stages of carbon dioxide radiolysis were examined from a viewpoint of energy conversion efficiency from radiation to chemical energy. The energy conversion efficiency in the physical stage was about 70%, and in the physicochemical stage about 40%. The back reaction in carbon dioxide radiolysis should be suppressed, which reduces product yields and lowers the energy conversion efficiency. Effects of additives such as propane and nitrogen dioxide, high absorbed doses, and fission fragment irradiation were studied experimentally. (Author)

A81-42901 Cell characteristics of various electrochemical photo-cells. K. Honda, A. Fujishima, and T. Inoue (Tokyo, University, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 753-763. 5 refs.

A description is presented of three types of electrochemical photocells with semiconductor photoelectrode/electrolyte junctions, classified according to the redox potentials in the solution species, and including a photoelectrolytic cell, a regenerative- and a heterogeneous-photovoltaic cell. Attention is given to sufficient solar absorption, separation of the photogenerated carriers, and rapid charge transfer at the electrode. Solar energy conversion efficiencies are presented. Design considerations include the following: (1) large output photovoltage based on good reversability of redox couples in the solution and large band bending of the semiconductor electrode; (2) sufficiently small resistance of the overall semiconductor-solution system; and (3) no filtering effect of the solution. K.S.

A81-42902 Fe2O3-coated Si electrodes for the photoelectrolysis of water. H. Morisaki, H. Ono, H. Dohkoshi, and K. Yazawa (University of Electro-Communications, Chofu, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 765-771. 9 refs.

A81-42903 Hydrogen evolution by photocatalytic reactions of some organic dyes and semiconductors. T. Sakata, T. Kawai (Institute for Molecular Science, Okazaki, Japan), T. Koiso, and M. Okuyama (Nagoya Institute of Technology, Nagoya, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 773-780. 16 refs.

Various organic dyes and powdered semiconductors are illuminated by visible light to bring about methylviologen - MV(2+) - reduction and hydrogen evolution from water, in an effort to study an 'artificial photosynthesis' process. MV(2+) is used as an electron acceptor, EDTA as an electron donor, and photochemical reactions are carried out both in nonaqueous solutions, such as dimethylsulfoxide, methanol, and in their mixtures with water. A 500W Xe lamp and a monochromator are used for monochromatic illumination at the peak wavelength of the visible absorption band of each molecule. The reduced MV(+) is monitored by a spectrophotometer, and a thermopile is used to determine the quantum efficiency of the reaction. Zn-chlorophyl-a and Zn-tetraphenylporphine show quite a high quantum efficiency. The preparation of the TiO2-RuO2 photocatalyst is described. The band gap illumination of TiO2 mixed with RuO2 leads to a continuous, catalytic production of hydrogen and oxygen from gaseous water at room temperature. The rate of hydrogen evolution per 100 mg of TiO2-RuO2, for 20 hours, is 11 micromoles at the stationary state. K.S.

A81-42904 A feasibility study of an airship as a LH2 tanker. T. Ishigohka (Seikei University, Musashino, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 817-822. 12 refs.

The use of an airship for transporting liquid hydrogen (LH2) is investigated, and a basic design along with two sets of specifications is proposed. Conventional means of transportation, i.e., marine and overland, are reviewed and dismissed, due to the large volume of the LH2. To use the electric power generated by the solar cells attached to the huge hull of the airship, the use of an electric propulsion system is proposed, and it is suggested that a superconducting generator and motor be used because of the fact that they are extremely lightweight. The economy of the use of such a system is stressed. K.S.

A81-42905 Surface properties of TiFe and TiFe-Nb 6.8 at% electrodes in aqueous solution. S. Fukushima and H. Tanabe (Muroran Institute of Technology, Muroran, Hokkaido, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 897-907. 9 refs.

Experiments are presented on TiFe and TiFe-Nb 6.8% (hydrogen chargeable intermetallic compounds) electrodes' ability to uptake hydrogen when cathodically polarized in an aqueous solution. The experimental procedure is described, and includes the preparation of the intermetallic compounds, the application of the potential sweep method to obtain the polarization characteristics of a sample electrode, and the behavior of the hydrogen absorbed by the electrode surface. It is shown that TiFe and TiFe-Nb 6.8% aid hydrogen evolution by an electrochemically catalytic effect which causes the formation of a mutual reaction layer between the electrode surface and the atomic hydrogen. The ability of the electrode surface to uptake hydrogen is improved (as are the electrode characteristics) by the addition of niobium. K.S.

A81-42910 * Hydrogen engines based on liquid fuels, a review. J. Houseman and G. E. Voecks (California Institute of

Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 949-968. 20 refs. Contract No. NAS7-100.

The concept of storing hydrogen as part of a liquid fuel, such as gasoline or methanol, and subsequent onboard generation of the hydrogen from such liquids, is reviewed. Hydrogen generation processes, such as steam reforming, partial oxidation, and thermal decomposition are evaluated in terms of theoretical potential and practical limitations, and a summary is presented on the major experimental work on conversion of gasoline and methanol. Results of experiments indicate that onboard hydrogen generation from methanol is technically feasible and will yield substantial improvements in fuel economy and emissions, especially if methanol decomposition is brought about by the use of engine exhaust heat; e.g., a methanol decomposition reactor of 3.8 provides hydrogen-rich gas for a 4 cylinder engine (1.952), and 80% of the methanol is converted, engine exhaust gas being the only heat supply. A preliminary outline of the development of a methanol-based hydrogen engine and a straight hydrogen engine is presented. K.S.

A81-42913 The effect of mixture strength and spark advance on detonation intensity in a small squish-chambered hydrogen fueled spark-ignition engine. M. A. Gammie and J. P. Bindon (Natal, University Durban, Republic of South Africa). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1001-1013. 21 refs.

A81-42916 Hydrogen application to gasoline automotive engines. A. N. Podgornyi and A. I. Mishchenko (Akademiia Nauk Ukrainskoi SSR, Institut Problem Mashinostroeniia, Kharkov, Ukrainian SSR). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1041-1053. 5 refs.

The use of hydrogen-enriched lean gasoline-air mixtures in automotive engines has been investigated experimentally with reference to ignition limits and the exhaust gas toxicity. It is shown that by changing the gasoline-hydrogen ratio in a fuel-air mixture, it is possible to achieve normal combustion with very lean mixtures (excess air ratio 6-7). During idle operation, only hydrogen with an excess air ratio of no more than 4 should be used. The use of a gasoline-hydrogen mixture is found to improve fuel economy by 20-25%, while the exhaust toxicity can be maintained well below the acceptable limits. V.L.

A81-42919 A liquid organic carrier of hydrogen as a fuel for automobiles. M. Taube (Zürich, Eidgenössische Technische Hochschule, Würenlingen, Switzerland) and P. Taube. In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1077-1085. 15 refs.

A system for hydrogen-fueled automobile fuel supply based on the use of a liquid organic hydrogen carrier is presented. The system relies on the catalytic conversion of methylcyclohexane to toluene at a heat of 315 C to supply hydrogen fuel to the engine, and the regeneration of methylcyclohexane from toluene at filling stations using electrolytic hydrogen. Advantages of the system include the use of exhaust gases to supply heat for dehydrogenation, small size, a automobile driving radius of up to 320 km, low thermal pollution, the use of waste heat for district heating, carrier toxicity the same as gasoline, low electricity requirements, and economic competitiveness, while disadvantages relate to the technology of catalytic reactors, hydrogenation by-product toxicity, and the complex design of the proposed filling station, which would include an electrolytic plant, hydrogenation plant, filling equipment and district heating system. It is concluded, however, that the system appears feasible. A.L.W.

A81-42920 LH2-car with a two-stroke direct injection engine and LH2-pump. Y. Kobayashi, S. Furuhama, M. Iida, and Y. Enomoto (Musashi Institute of Technology, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1087-1101. 13 refs.

A two-stroke low-temperature direct injection engine and associated fuel supply system have been developed for a small-sized hydrogen-fueled passenger car. The engine includes an injector installed at the center of the cylinder heads which injects the fuel at a pressure of 1 MPa immediately after the closure of the exhaust port. Tests of the effects of air throttling on engine thermal efficiency and NO(x) emission have shown that during engine operation, air should be so throttled that mixtures of air excess ratio of 2 or more should not become leaner. The injection of fuel in a conical shape between the valve and the seat has been found to be preferable for fuel mixing, while the injection of cold (-30 C) fuel has been shown to suppress abnormal combustion (preignition) and reduce NO(x) emission. The fuel supply system consists of a liquid hydrogen tank, a synthetic piston pump for LH2 pumping at 1 MPa and a heat exchanger and reservoir to control injection fuel temperature. The engine and fuel supply system have been mounted in a Suzuki-Cervo minicar, which has achieved a maximum range of 350-400 km and top speed of 118 km/h. Future objectives include the improvement of the fuel tank and the development of a high-pressure LH2 pump. A.L.W.

A81-42921 Mixture formation and combustion in interaction with the hydrogen storage technology. K. Binder and G. Withalm (Daimler-Benz AG, Stuttgart, West Germany). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1103-1117. 15 refs. Research supported by the Bundesministerium für Forschung und Technologie.

Mixture formation systems which offer hydrogen in various pressure and temperature ranges are discussed, and a concept for a safe hydrogen engine with favorable fuel consumption is developed. Problems considered include irregular combustion due to preignition in the intake and compression phases, knocking combustion, and low output due to volumetric efficiency loss. Storage technology is also discussed. Disadvantages are found to be reduced by the selection of the mixture formation, with the selection partly dependent on the storage technology employed. The combination of external mixture formation and hydride storage unit, although requiring water injection, is found to be the most favorable system. Finally, cryogenic technology combined with an external mixture formation is considered as a future possibility. D.L.G.

A81-42923 Catalytic combustion of hydrogen - Development of oxide catalysts and experimental tests for combustor design. M. Haruta, Y. Souma, and H. Sano (Osaka, Government Industrial Research Institute, Ikeda, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 1135-1147. 11 refs.

The development of novel composite oxide catalysts for low temperature catalytic combustion of hydrogen is described, along with experimental tests concerned with combustor design. The screening of potential catalysts showed that simple transition metal oxides could catalyze the combustion of hydrogen at temperatures somewhat above 100 C, and the investigation of composite oxide activities allowed the formulation of a highly active catalyst comprising Co and Mn oxides promoted by a small amount of Ag oxide. This catalyst has activities comparable to those of a supported Pd catalyst with low metal loading, and displayed good durability at high temperatures. O.C.

A81-42926 The diffusive combustion of hydrogen. A. Melvin (British Gas Corp., London, England). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2.

44) Oxford and New York, Pergamon Press, 1981, p. 1177-1186. 6 refs.

Theoretical modeling of catalytic combustion processes are discussed with emphasis on chemical and fluid dynamic factors controlling the stability of hydrogen diffusion flames. A study is also made to investigate the technique of diffusive catalytic combustion of hydrogen, and the conditions under which combustion occurs. A hydrogen diffusion flame is found less easily quenched than one of methane, and a streamlined refraction process is observed to drive oxygen by forced convection to the fuel side of the flame sheet. In addition, a maximum temperature of combustion in excess of 650 K prevented nitrogen oxides from forming, but allowed several percent of the hydrogen to escape from the catalyst bed, creating an explosion hazard. It is concluded that the technique's novel application is attractive; however, difficulties do exist with unburnt fuel emissions, and further research is required. D.L.G.

A81-42930 An ammonia energy vector for the hydrogen economy. L. Green, Jr. In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1265-1272. 25 refs.

This paper proposes the use of ammonia as a multipurpose energy vector. Synthesized from hydrogen produced in a large, centralized facility using nuclear process heat from a high-temperature, gas-cooled reactor (HTGR), the ammonia serves as a low-cost vehicle for energy storage and transmission, via pipeline, to remote demand centers where some of it serves as a clean-burning fuel for local cogeneration and process heat applications, and some of it is used for direct agricultural application or as feedstock for production of nitrogen-based fertilizers or other chemical processes. (Author)

A81-42931 Hydrogen as a fuel - Production. C. Schmidt (Comisión Chilena de Energía Nuclear, Santiago, Chile). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1317-1326. 5 refs.

Methods for the production of hydrogen as a fuel using different technologies are evaluated from a technical and economical point of view. The main characteristics of hydrogen are considered, and its properties are compared to those of methane and gasoline. Electrolysis is viewed as the most likely process for practical large-scale H2 production and offers the greatest potential for meeting necessary capital requirements. Thermochemical production of H2 offers the best efficiency (all by-products can be reinjected into the process), but lacks practical experience. Chemical production of H2 using coal as a primary raw material would be practical for countries with large resources of cheap coal. The low boiling point (-433 F), low gaseous density (0.005 lb/cu ft), and low energy requirements of H2 make its storage and transport the most difficult of all synthetic fuels. Moreover, the price of H2 is not competitive with the present price of petroleum. The production of synthetic natural gas and hydrogen is expected to have economical advantages in the near future. J.F.

A81-42932 Presentation of a long-term energy system based on electricity and hydrogen vectors. C. Derive, J. Y. Portas (Electricité de France, Direction des Etudes et Recherches, Paris, France), M. Portier, and J. P. Roncato (Gaz de France, Direction des Etudes et Techniques Nouvelles, Paris, France). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1327-1343. 5 refs.

The problems associated with the design of an energy system based on a nuclear primary source are discussed with two main vectors: electricity and hydrogen. The advantage of hydrogen electrolysis in a long-term policy through the possibilities of seasonal transfer for nuclear energy is examined, and the R&D targets of involved techniques are outlined. An energy demand model, based on an analysis of the socioeconomic system outlining formation and evolution of energy needs, is presented. It is a simulation model, estimating energy consumptions and seasonal changes for various economic sectors. An optimization of the overall system, including production, transformation and consumer end-use devices, is achieved through a linear programming model, involing energy supply and demand, eefficiency and investment cost of all equipment. The technical and economical conditions of hydrogen development and its profits are discussed according to the results obtained for three scenarios for France in 2020. J.F.

A81-42933 Assessment of the potential future market in Sweden for hydrogen as an energy carrier. G. Carleson (Studsvik Energiteknik AB, Nykoping, Sweden). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1345-1359.

Future hydrogen markets for the period 1990-2025 are projected, the probable range of hydrogen production costs for various manufacturing methods is estimated, and expected market shares in competition with alternative energy carriers are evaluated. A general scenario for economic and industrial development in Sweden for the given period was evaluated, showing the average increase in gross national product to become 1.6% per year. Three different energy scenarios were then developed: alternatives were based on nuclear energy, renewable indigenous energy sources, and the present energy situation with free access to imported natural or synthetic fuels. An analysis was made within each scenario of the competitiveness of hydrogen on both the demand and the supply of the following sectors: chemical industry, steel industry, peak power production, residential and commercial heating, and transportation. Costs were calculated for the production, storage and transmission of hydrogen according to technically feasible methods and were compared to those of alternative energy carriers. Health, environmental and societal implications were also considered. The market penetration of hydrogen in each sector was estimated, and the required investment capitalllll was shown to be less than 4% of the national gross investment sum. J.F.

A81-42934 Hydrogen and fresh water production from sea water. A.-M. A. El-Bassuoni, J. W. Sheffield, and T. N. Veziroglu (Miami, University, Coral Gables, FL). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1361-1372. 8 refs.

A review was made of hydrogen production as a source of energy. Hydrogen from sea water has mainly been produced by electrolysis. The chlorine and oxygen evolved at the anode makes this process very difficult. A proposal for hydrogen production from sea water by an electrochemical method is under investigation. In this investigation, fresh water and hydrogen can be produced simultaneously. The electric cell consists of a set of electrodes. Each electrode is suspended between two plastic membranes (cations and anions). Hydrogen will be evolved from the cation compartment and chlorine gas from the anion compartment. Cost estimation and evaluation of the process was made. (Author)

A81-42935 Status of EPRI's hydrogen program. B. R. Mehta (Electric Power Research Institute, Palo Alto, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1407-1414. 17 refs.

EPRI has, through a series of techno-economic studies, market evaluations and a survey of utility consumption of hydrogen, determined that: (1) hydrogen produced by water electrolysis could be of near term benefit to the utilities, (2) other thermochemical water splitting cycles do not offer significantly lower costs or improved efficiencies and (3) developing reliable, cost-effective water electrolyzers for utility applications would establish a 'hands-on' technological basis. The R&D strategy and program plans to develop small (20-50 kW) electrolyzers for generator cooling and its evolutionary growth towards use of hydrogen as an energy carrier are presented. (Author)

A81-42936 Solar-hydrogen energy system-model applied to isolated island. A. Ohsato, T. Hiki, S. Itoh, T. Sekiguchi, and T. Ohta (Yokohama National University, Yokohama, Kanagawa, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26,

1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1415-1430.

An energy system model is evaluated based on the case where an industry is introduced to an isolated island. A hybrid system is assumed, composed of the petroleum energy, solar energy, hydrogen energy, and electric power systems. The optimum economy and policy for the system is investigated using computer-aided linear programming (LP) and quadratic programming (QP) methods. The LP and QP modeling strategies proved useful when only economy was considered, but a modified LP model had to be used when environmental protection and acquisition stability were evaluated. The LP and QP models showed that the petroleum system is superior to the solar-hydrogen energy system in the present energy situation (considering an interrelationship between acquisition prices, conversion ratios, and transport prices), but a greater dependence on solar-hydrogen energy is expected for the future. The optimum policy of the system based on the modified LP model, however, showed the solar-hydrogen energy system to be superior to the petroleum system. J.F.

A81-42937 The use of solar energy - photovoltaic - in hydrogen production and arid zones like Saudi Arabia. A. A. M. Sayigh (Riyadh, University, Riyadh, Saudi Arabia). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1431-1439. 5 refs.

This paper deals with the use of photovoltaic technology for the production of hydrogen from water by electrolysis. First of all the amount of electricity needed for this process was assessed, then various types of solar cell systems to generate the electricity needed were discussed and the best system was established. Some of the investigations involved testing of solar cells with concentrators and with fixed tilt or tracking devices. Several small panels of solar cells were used in testing the effect of local dust and sand as well as the fixed tilt in the area of Riyadh. The cost of producing hydrogen by electrolysis using electricity from a conventional grid was calculated. This cost was compared with the cost of production of hydrogen if a solar cell array was used. The paper outlines the continuous price increase of oil to produce electricity and the rapid decrease in price of solar cells. Both these advances will lead to a cheaper way of producing hydrogen by solar energy. In addition it is shown that technology is almost trouble free and requires very little know-how as far as operation is concerned. (Author)

A81-42938 OTEC to hydrogen fuel cells - A solar energy breakthrough. J. R. Roney (Princeton Energy and Environmental Research Co., Princeton, NJ). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1441-1451. 11 refs.

Recent advances in fuel cell technology and development are discussed, which will enhance the Ocean Thermal Energy Conversion (OTEC)-hydrogen-fuel cell mode of energy utilization. Hydrogen obtained from the ocean solar thermal resources can either be liquified or converted to ammonia, thus providing a convenient mode of transport, similar to that of liquid petroleum. The hydrogen fuel cell can convert hydrogen to electric power at a wide range of scale, feeding either centralized or distributed systems. Although this system of hydrogen energy production and delivery has been examined with respect to the U.S.A., the international market, and especialy developing countries, may represent the greatest opportunity for these future generating units. J.F.

A81-42939 Sea water for hydrogen and for municipal use. M. A. K. Lodhi (Texas Tech University, Lubbock, TX). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1453-1457.

The production of hydrogen from sea water using solar energy is discussed, and a set of parameters for the project is worked out. The energy produced by electrolysis is directly proportional to the rate of evaporation. If the water is collected in a sink reservoir from the sea and solar energy is used directly to produce hydrogen, the evaporation rate will increase and more hydraulic energy will be available. The end-product of hydrogen electrolysis is fresh water, which can be used for domestic, industrial, or agricultural purposes. Letting this water evaporate into the atmosphere might increase the humidity and lead to some environmental hazards. The cost of hydrogen production is currently greater than that of other conventional energies, despite its low transportation and distribution costs. J.F.

A81-42941 Hydrogen transfer and storage electrode systems. F. A. Lewis (Queen's University, Belfast, Northern Ireland). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1481-1483. 23 refs.

Electrode materials which can absorb and store large volumes of hydrogen are studied. These hydrogen storage electrodes, used in fuel cell systems, have additional application in hydrogen/hydrogen concentration or transfer cells. The catalytic activity and local cell hydrogen transfer processes at electrode services are discussed. Hydrogen mobility within both the storage material and the electrolyte, and the extent of concurrent evolution of hydrogen gas are considered. Variations of the chemical potential of the stored hydrogen are viewed as a function of the nature and storage capacity of the electrode material. The possibility of deformation of electrodes in cycles of use, resulting from expansions and contractions of the electrode material, as well as inhomogeneous stress distributions, necessitates consideration of such factors as hydride phase transitions and Gorsky effect phenomena. J.F.

A81-42943 Energy analysis of electrochemical systems for utilization and production of hydrogen. S. Yamauchi and K. Fueki (Tokyo, University, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1509-1518.

General aspects of energy analysis on electrochemical systems, electrolysis and fuel cell, are discussed. The first law of thermodynamics yields an enthalpy flow analysis. The second law yields an exergy flow analysis. Causes for exergy losses are discussed. They are (1) heat flow from the system, (2) generation of heat by dissipation process in the system such as overpotential and ohmic loss, and (3) a heat transfer process to heat the reactant to the reaction temperature. Explicit expressions are given for the exergy losses by these causes. (Author)

A81-42944 Operating characteristics of a LH2 fueled car and of a semiautomatic LH2 refueling station. W. Peschka (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Stuttgart, West Germany). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1561-1576. 8 refs.

Basing on earlier papers new test results and experiences are reported about refueling of LH2 automobile tanks by means of a semiautomatic refueling station described in an earlier paper. This refueling unit, designed and constructed only for the purpose of demonstration of liquid hydrogen handling by untrained people has been tested now for refueling of a LH2-car. On this car a special designed LH2-tank is mounted described in an earlier paper. The engine became converted for hydrogen fuel, but a switchback to gasoline fuel is possible by means of very simple manipulation. The vehicle and the refueling station were tested succesfully and are now in continuous operation for the demonstration of handability of LH2 fuel. The experiences made are encouraging and enable suggestions and recommendations for design and construction of safe LH2 fueled cars. (Author)

A81-42947 Analysis of a gas turbine and steam turbine combined cycle with liquefied hydrogen as fuel. Y. Tsujikawa and T. Sawada (Osaka Prefecture, University, Sakai, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1623-1635. 5 refs.

The performances of a combined cycle driven by the liquid

hydrogen are discussed. The cycle consists of a gas turbine with a precooler system, and a steam turbine heated by the exhaust energy of gas turbine. The liquid hydrogen has not only chemical but also low temperature exergy. The latter is about 10 per cent of the total exergy and is converted to the useful work through the precooling system and an auxiliary hydrogen turbine. The specific output and thermal efficiency of the combined cycle are much higher than those of a simple cycle gas turbine, but in order to succeed the combined cycle, it is necessary to check the pinch point which may take place in the boiling process which is heated by the exhaust energy of gas turbine. (Author)

A81-42949 The use of non-fossil derived hydrogen in coal conversion processes. J. S. Harrison, D. Merrick, M. Smith, and G. Rasmussen (Coal Research Establishment, Stoke Orchard, Glos., England). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1661-1678.

The National Coal Board, UK, carried out a technical and economic study of the use of non-fossil derived (NFD) hydrogen on three coal conversion processes: methanol synthesis, solid phase hydrogenation (hydrogasification) for substitute natural gas production, and liquid phase hydrogenation (liquifaction) for the manufacture of liquid fuels. Use of NFD hydrogen generally resulted in an increase in the conversion efficiency and carbon utilization, and a reduction in the number of component stages of the process. It was also shown that market conditions could exist in which the use of NFD hydrogen in coal conversion would be preferable to both conventional coal conversion and the direct use of hydrogen, irrespective of the coal price. Substitute natural gas production from synthesis gas (methanation) and the production of liquid fuels from synthesis gas by a Fischer-Tropsch synthesis route were also evaluated and showed similar technical and economic results. Preliminary results of the overall costs of using NFD hydrogen from a nuclear power/electrolysis plant showed that at present fuel prices, coal conversion processes using NFD hydrogen are not competitive with conventional processes, but would be if the price of coal were to double. J.F.

A81-42950 A balanced energy budget plan for hydrogen production and distribution. R. G. Williscroft (NOAA, Atlantic Marine Center, Norfolk, VA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1679-1696. 29 refs.

An integrated plan for hydrogen production and distribution within a balanced energy budget is outlined. Primary energy source is the sun, concentrated in earth orbit by satellite and beamed to selected planetside marine locations for hydrogen production from sea water. Primary distribution via already existent natural gas pipeline networks upgraded for hydrogen transmission is augmented by local network extensions and by surface marine transport using modified LNG carriers. The economic, social and environmental impact of this integrated approach is examined in its relationship to continued reliance upon fossil fuel and expanded use of nuclear fission, to increasing reliance upon so-called alternative energy sources, and to the forthcoming nuclear fusion option. (Author)

A81-42951 An efficient path of hydrogen production and consumption. N. Goto, A. Suzuki, and R. Kiyose (Tokyo, University, Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 3. Oxford and New York, Pergamon Press, 1981, p. 1697-1706. 10 refs.

A mathematical model of the long-term transitional dynamics of an energy system from conventional to nuclear energies was constructed to assess hydrogen fuel. For illustration, a couple of types of hydrogen production processes, large-scale electrolysis and HTGR thermochemical decomposition of water, were considered. Much emphasis was placed upon estimating the expected benefit obtained from the HTGR hydrogen production technology R&D program by making comparison between the cases where the program will succeed in the year 2000 and in the year 2030. There are a lot of uncertain parameters associated with the assessment. The result, however, suggests that not static but marginal production costs are an indicator for hydrogen economy, reflecting all the relevant situations being considered in the model. (Author)

A81-42952 Recent review of thermochemical hydrogen production. G. E. Beghi (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1731-1748. 36 refs.

A survey is presented on the development to date of thermochemical water decomposition methods for the production of hydrogen. It is shown that: (1) both the technological feasibility of thermochemical processes and their competitiveness with water electrolysis have been demonstrated; (2) the scaling up of thermochemical methods to industrial production levels may proceed with existing technology; (3) the slowing down of programs concerned with the development of high temperature nuclear reactors could delay the scaling up of thermochemical hydrogen production to industrial levels; (4) this delay could, however, increase interest in such water decomposition processes as those employing photoreactions; and (5) the efficiency of thermochemical hydrogen production is highest in the case of systems with dedicated heat sources rated above 1000 MWth. O.C.

A81-42953 Recent advancements in water electrolysis systems in the United States. R. R. Reeves (U.S. Department of Energy, Office of Advanced Conservation Technologies, Washington, DC) and C. S. Grant (Aerospace Corp., El Segundo, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1785-1795. 7 refs.

The recent advancements and status of water electrolysis technology in the United States is discussed. Near-term demonstration and commercialization opportunities for advanced-state electrolyzers exist. The gap between the state-of-the-art technology and the technology necessary to make use of these opportunities is closing. Development of each unique and new application will act synergically to bring this technology into its full fruition. (Author)

A81-42954 Recent developments on IME-alkaline water electrolysis. H. Vandenborre, L. H. Baetslé, W. Hebel, R. Leysen, H. Nackaerts, and G. Spaepen (Centre d'Etude de l'Energie Nucléaire, Mol, Belgium). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1809-1815. Research sponsored by the Commission of the European Communities.

Demonstration on a laboratory scale is reported for the substitution of the conventional asbestos diaphragm in alkaline water electrolysis processes by thin sheets of polyantimonic acid and polysulfone. The membranes investigated withstand concentrated KOH solutions at up to 120 C, and have the necessary ion-conducting and gas-separating properties. It was also found that, by increasing the amount of polyantimonic acid in the membrane, electrolyte concentration can be lowered from 30 percent to 5 percent (by weight) without major effect on the cell voltage. O.C.

A81-42955 Advanced unipolar electrolysis. R. L. LeRoy and A. K. Stuart (Electrolyser, Inc., Etobicoke, Ontario, Canada). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1817-1830. 26 refs.

Substantially reduced capital costs and an efficiency exceeding 85% are foreseen for advanced unipolar electrolyzers. The new equipment preserves the recognized advantages of the unipolar design. Two generations of electrolyzer development are discussed. The first generation is based on conservative modifications to proven commercial designs and on the use of electrode activation. The resulting concepts have been fully demonstrated, and representative data are presented. The second-generation designs incorporate modifications which allow operation at current densities above kA sq m. Results are reported which demonstrate feasibility in pilot cells. Both generations of advanced-unipolar electrolyzers will produce hydrogen at atmospheric pressure. Compression costs are reviewed. It is concluded that hydrogen compression external to the gas-

generating equipment is preferred over electrolysis at high pressures, for reasons of safety and economy. (Author)

A81-42958 Progress in water electrolysis at the conclusion of the first hydrogen programme of the European Communities. G. Imarisio (Commission of the European Communities, Brussels, Belgium). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1865-1872. 11 refs.

A review is presented of the progress in water electrolysis achieved by the first hydrogen production research and development program of the European Community. Among the program achievements cited are: (1) the development of promising anodic and cathodic electrocatalysts for both low temperature (80-120 C) and medium temperature (160-200 C) alkaline water electrolysis processes; (2) the development of several diaphragm and/or membrane materials which display good performance in the low temperature range, as well as promising diaphragms for medium temperatures; and (3) the confirmation of laboratory results through long term testing in small prototype installations. O.C.

A81-42959 Porous nickel electrodes in water electrolysis. I - Electrode preparation and polarisation studies in strong alkali. II - Use of porous nickel electrodes in multicell module. P. Ragunathan, S. K. Mitra, and M. G. Nayar (Bhabha Atomic Research Centre, Bombay, India). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1873-1900. 5 refs.

Replacement of 'plate' electrodes in water electrolysis cells by porous nickel electrodes leads to many advantages resulting in reduced specific energy consumption for hydrogen production. This paper describes the techniques developed to prepare the porous electrodes, their physical characteristics and their performance in strong alkali as hydrogen and oxygen gas electrodes. Steady state cell polarization studies over a range of 100 to 10,000 ASM at different temperatures were carried out in 6N K OH solution for different electrode samples prepared by alloy electrodeposition and powder metallurgy methods. Electrodes from these two methods were compared with respect to their electrochemical performance. The current carrying capacity at a given overvoltage was evaluated for different electrode thicknesses. Use of porous electrodes in electrolysis modules permits high current density operation at reduced cell voltages because the specific surface area in porous electrodes increases manifold due to fine pores and large pore densities. But the use of porous electrodes also imposes certain restrictions in design and operation of the module. The increased current densities cause high heat and gas generation fluxes within a small cell space, with the gases being released in the form of very fine bubbles. The above aspects are discussed in detail and the experimental studies carried out on the porous nickel electrodes to determine the bubble size, gas release and separation at different current densities are reported. Description of an electrolyzer of 1.5 cu nm/hr capacity and operation of the module with porous electrodes are given. (Author)

A81-42961 An early application of the Sulfur Cycle Hydrogen Production Process. G. H. Parker, G. H. Farbman, and W. A. Summers (Westinghouse Electric Corp., Pittsburgh, PA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 1921-1927. 5 refs.

The electrochemical step of the Sulfur Cycle Hydrogen Production Process can be commercialized irrespective of the success or failure of activities in development of the high temperature thermochemical or heat source technologies. This version of the Sulfur Cycle, called the 'open-cycle', uses sulfur dioxide and water to produce two marketable products, i.e., hydrogen and sulfuric acid. An attractive application of the open-cycle has been identified in improving the gas cleanup systems for coal fired power plants. Analyses indicate that the revenues that could be realized by the power plant operator from the sale of hydrogen and sulfuric acid exceed the costs of owning and operating the Sulfur Cycle 'add-on' to the power plant. (Author)

A81-42969 Formation and properties of titanium-manganese alloy hydrides. T. Gamo, Y. Moriwaki, N. Yanagihara, T. Yamashita, and T. Iwaki (Matsushita Electric Industrial Co., Ltd., Central Research Laboratories, Moriguchi, Osaka, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2127-2143. 26 refs.

The measurement of pressure-composition isotherms in the temperature range 0-80 C was used in a study of the hydride formation and hydriding properties of Ti-Mn alloy systems. These systems have a hexagonal structure of MgZn2(Cl4) type known as the Laves phase. It was found that the Ti-Mn binary alloys whose atomic Ti content was less than 36% absorbed almost no hydrogen, while those containing more readily reacted with hydrogen at room temperature without any activation treatment. Ternary, quaternary and quinary alloys of the Ti-Mn system incorporating such transition metals as Zr, V, Cr, Fe, Co, Ni, Cu, Nb, Mo, Ta, La, and Ce were also studied, and the dissociation plateau pressure at 20 C was obtained in a range from 0.01 MPa to 1 MPa. O.C.

A81-42970 Thermal conductivity of metal hydride beds. S. Suda, N. Kobayashi (Kogakuin University, Hachioji, Tokyo, Japan), and K. Yoshida (Sekisui Chemical Industry, Central Research Laboratory, Osaka, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2157-2168. 8 refs.

Experimental results on the thermal conductivity and hydrogen absorption and desorption behavior of the TiMn1.5 hydride are correlated by means of a kinetic theory of gas and equilibrium behaviors. The effective thermal conductivity of the hydride is defined as the sum of two independent terms related to pressure and composition, and an empirical equation based on the experimental data is derived for the TiMn1.5 hydride. O.C.

A81-42972 Turbocharging the hydrogen-fueled internal combustion engine. F. Lynch (Denver, University, Denver, CO). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2257-2271.

Naturally aspirated, turbocharged and turbocharged-aftercooled configurations of spark-ignited, hydrogen-fueled Caterpillar 3304 are compared with the standard naturally aspirated diesel. Power, fuel consumption, and emissions are compared. Turbocharging the hydrogen engine provides power and fuel consumption data comparable to the naturally aspirated diesel while maintaining extremely low emissions. (Author)

A81-42973 Environmental impact of one year experience with a hydrogen bus. R. M. Zweig (Clean Fuel Institute, Riverside, CA). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2273-2285. 16 refs.

An overview is presented of a municipal transportation system's hydrogen bus demonstration program. In addition to the operational and safety aspects of the system, the study undertook a detailed analysis of combustion emission pollutants during a year of operation. Among the air pollutants monitored were carbon monoxide, sulfur and nitrogen oxides, lead, photochemical oxidants such as ozone, and various hydrocarbons and particulates. It is concluded that while widespread adoption of hydrogen as a transportation fuel will greatly improve air quality, maintenance requirements will have to be significantly reduced in vehicles if they are to become economically feasible and metal hydride storage systems will have to become the norm in municipal bus design. O.C.

A81-42974 A three compartment electrolytic cell for anodic oxidation of sulfur dioxide and cathodic production of hydrogen. B. D. Struck, R. Junginger, D. Boltersdorf, and H. Neumeister (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980.

Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2315-2322. Commission of the European Communities Contract No. 511-78.

A81-42975 Prospects on hydrogen production for a generalized domestic, industrial and automotive, usage. D. Dini (Pisa, Università, Pisa, Italy). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2363-2375.

Assuming the availability of advanced nuclear and solar systems as prime energy sources for electrolytic production of hydrogen, an assessment is made of high pressure electrolytic gasification, liquefaction and storage work requirements. Also, a pipeline network and associated equipment for the delivery and storage of hydrogen are considered in the context of a future replacement of all fossil fuels by hydrogen. Attention is given to space-based systems and terrestrial photovoltaics. O.C.

A81-43165 # Hydrogen fueled catalytic combustion for low thrust expendable turbojet engine. W. C. Elrod (USAF, Institute of Technology, Wright-Patterson AFB, OH), J. D. Durniak (USAF, Carswell AFB, NM), and L. E. Taylor. *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1715.* 5 p. 8 refs.

The performance of low cost expendable turbojet engines established from commercially available automotive type turbosuperchargers was investigated. The engine development centered primarily around obtaining a combustor design that would provide acceptable performance. Several types of combustors, both conventional and non-conventional, were examined. A hybrid design evolved incorporating fuel injection into a low velocity recirculation region in the dome followed by a catalytic element and requiring no ignition system when operated with hydrogen fuel. In addition, the catalytic element served to reduce the pattern factor at the combustor exit and should insure complete reaction of the fuel/air mixture. (Author)

A81-43999 Hydrogen energy - An inexhaustible abundant clean energy system. M. G. Nayar (Bhabha Atomic Research Centre, Bombay, India). *Indian Academy of Sciences, Proceedings (Engineering Sciences),* vol. 4, Apr. 1981, p. 57-73. 17 refs.

A review is presented of various hydrogen production processes from possible primary energy resources. The processes covered are nuclear coal gasification, thermochemical hydrogen production, and hydrogen production by electrolysis, which includes solid polymer electrolyte-based electrolyzers, high-temperature electrolyzers, and photoelectrochemical decomposition of water. Attention is given to hydrogen transport and storage (in metal hydride systems) and to its application as an automotive fuel. Hydrogen as a secondary energy source is also discussed, and its uses as an off-peak power storage medium and as an energy transmission medium are described. Costs, flow diagrams and chemical formulas are analyzed in detail. K.S.

A81-45099 The activation of FeTi for hydrogen storage - A different view. T. Schober and D. G. Westlake (Argonne National Laboratory, Argonne, IL). *Scripta Metallurgica,* vol. 15, Aug. 1981, p. 913-918. 26 refs. Research supported by the U.S. Department of Energy.

FeTi has to be activated before it will absorb hydrogen. Typically this activation is achieved by heating for 1 h at 400 C in H2 at a pressure of 2 MPa. In the current study, transmission electron microscopy is used to investigate the initial phases of the activation process for FeTi. A new model for the activation of FeTi is suggested on the basis of the results of the investigation. Annealing of FeTi in vacuum or hydrogen at low p(O2) levels results in catalytically active, bare FeTiOx surfaces via dissolution of the original oxide skin in the matrix. Additional catalytic activity is provided by islands of n-TiO2 (rutile) which are in epitaxial contact with the FeTi matrix. Simultaneously, clusters of Fe2Ti are formed via the reaction 2FeTi+O2 yields Fe2Ti+TiO2. New catalytic FeTi surface area is repeatedly created by cracking during the desorption cycles of the activation. G.R.

A81-47242 The possibilities of hydrogen in the large-scale utilization of solar energy (Einsatzmöglichkeiten von Wasserstoff bei grosstechnischer Solarenergienutzung). J. Nitsch and T. Schott (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Technische Physik, Stuttgart, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 307-319. In German.

It is noted that hydrogen is a promising energy carrier for use in the existing energy distribution system in Europe. The possible role of solar-generated hydrogen in the Federal Republic of Germany is considered in the framework of an energy scenario for the year 2050. The problems of availability and reliability are examined, assuming a large contribution from solar energy. The generation, storage, and transport of hydrogen is examined for realistic cases; and the costs of solar-generated hydrogen are estimated. B.J.

A81-47244 Hydrogen storage through adsorption (Speicherung von Wasserstoff durch Adsorption). H. Ewe, P. Brennecke, E. W. Justi, and H.-J. L. Selbach (Hamburg, Fachhochschule, Hamburg, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 331-336. In German.

Hydrogen can be stored by its reversible adsorption on the surface of a highly disperse adsorbent. The use of activated carbon with low specific weight and large surface is examined. The adsorption and desorption of hydrogen on several types of carbon were studied by means of a gravimetric sorption balance in the 77-300 K temperature range. At 77 K and 1 bar hydrogen pressure, up to 258 N cu cm hydrogen were adsorbed by 1 cu cm of the porous carbon. The apparent density of the carbon was determined to be 0.36 g/cu cm; accordingly, the weight of the adsorbed and stored hydrogen was 5.97% of the carbon weight, and the C:H ratio was about 3:1. B.J.

A81-48031 Hydrogen absorption and desorption characteristics of ferro-titanium alloys. M. Kitada (Hitachi, Ltd., Central Research Laboratory, Tokyo, Japan). *Journal of Materials Science,* vol. 16, Sept. 1981, p. 2527-2530.

Hydrogen absorption and desorption characteristics of commercially supplied ferro-titaniums with 41 to 51 at.% Ti have been studied. The characteristics are similar to those of high purity FeTi although the ferro-titaniums include some impurities. The activation temperatures of the ferro-titaniums are slightly higher than that of the high purity FeTi. Plateaus in the hydrogen absorption and desorption curves are not obvious compared with those of high purity FeTi. It is concluded that the ferro-titaniums are good, low-cost hydrogen storage materials. (Author)

A81-49249 Hydrogen production by marine photosynthetic bacteria - Effect of environmental factors and substrate specificity on the growth of a hydrogen-producing marine photosynthetic bacterium, Chromatium sp. Miami PBS 1071. Y. Ohta, J. Frank, and A. Mitsui (Miami, University, Miami, FL). *International Journal of Hydrogen Energy,* vol. 6, no. 5, 1981, p. 451-460. 24 refs. Research supported by the Solar Energy Research Institute.

A81-49725 Thermochemical and hybrid cycles for hydrogen production - A differential economic comparison with electrolysis. R. Shinnar, D. Shapira, and S. Zakai (City College, New York, NY). *I & EC - Industrial and Engineering Chemistry, Process Design and Development,* vol. 20, Oct. 1981, p. 581-593. 30 refs. Research supported by the Electric Power Research Institute.

A method for economic evaluation of new processes is presented. The method is especially suitable for evaluating new technology at a stage where much of the detailed process information is still missing. It is based on differential comparison of the new process with available technology for focusing on evaluating its advantages in dealing with stochiometric, thermodynamic, and process constraints and the interactions between them. The method is demonstrated by performing thorough evaluation of a class of processes that has been proposed for generation of hydrogen from nuclear reaction. The paper shows that one can conclude that the processes that have been

proposed in the literature are inferior to electrolysis of water and that this conclusion can be obtained without any detailed process information using only available thermodynamic properties of the components involved. (Author)

A81-49949 # **Hydrogen engines (Dvigateli na vodorode).** V. P. Barmin (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR), I. L. Varshavskii, and V. V. Goncharov (Akademiia Nauk SSSR, Institut Mashinovedeniia, Moscow, USSR). *Priroda*, Sept. 1981, p. 22-25. In Russian.

The development of internal combustion engines fueled by hydrogen or hydrogen mixtures is reviewed. The first systematic investigations in the 1920s of a one-cylinder engine with variable compression ratio, which demonstrated the possibility of qualitatively regulated hydrogen combustion at any range of loading, resulting in a greater engine efficiency, is discussed, and problems of premature ignition encountered due to the use of pure hydrogen fuel are noted along with a possible solution in the use of a special injector for the direct delivery of the hydrogen to the cylinder which, however, leads to strong knocking. Attention is then given to work begun in 1974 on an experimental one-cylinder hydrogen-air engine with various degrees of compression and hydrogen supplied from ferrosilicon and water, the improvement of gasoline engine operating efficiency by 5-10% additions of hydrogen, hydrogen addition to diesel fuels, and hydrogen addition to improve the carbon monoxide, hydrocarbon and NO(x) emissions levels of aircraft gas turbine engines. A.L.W.

N81-28287# Brookhaven National Lab., Upton, N. Y.
HYDROGEN PRODUCTION FROM SMALL HYDROPOWER SITES Final Report
Apr. 1980 83 p
(Contract DE-AC02-76CH-00016)
(BNL-51309) Avail: NTIS HC A05/MF A01

A synergistic relationship was not found to exist between low head hydropower and electrolytic hydrogen production. The storageability of hydrogen was expected to mitigate problems of hydrogen generation variability associated with the use of low head hydropower as the power source. The expense of gaseous hydrogen storage equipment effectively eliminates storage as a means to decouple hydrogen demand and power/hydrogen production. From the opposite perspective, the availability of a low and stable cost of power from low head hydro was expected to improve the competitiveness of electrolysis. In actuality, the results indicated that hydroelectric power from small dams would be comparatively expensive by current grid power standards (mid 1979). Electrolysis, in the capacity range considered here, is less sensitive to the cost of the power than originally presumed. Other costs including depreciation and capital related charges are more significant. DOE

N81-29252*# Escher-Foster Technology Associates, Inc., St. Johns, Mich. Alternative Fuels Utilization Program.
HYDROGEN-VIA-ELECTRICITY CONCEPT. CRITIQUE REPORT
W. J. D. Escher Jan. 1981 78 p refs Sponsored in part by NASA and DOE
(NASA-CR-164546; DOE/CE-0005) Avail: NTIS HC A05/MF A01 CSCL 07D

The hydrogen-via-electricity (HvE) concept is the prospective use of hydrogen fuel produced electrolytically from the electric utility grid as a means of responding to conventional fuels shortages. The two sets of comments and critiques of this concept solicited from the Government/Government contractor group and from the electric utility companies are presented. DOE

N81-29264# Los Alamos Scientific Lab., N. Mex.
HYDROGEN PRODUCTION BY FLUID-BED RETORTING OF OIL SHALE
J. W. Barnes May 1981 24 p refs
(Contract W-7405-eng-36)
(LA-8832-MS) Avail: NTIS HC A02/MF A01

The oil produced from retorting of oil shales for refining into marketable products are discussed. Hydrogen requirements can be met by partial oxidation of a fraction of the shale oil produced or by direct processing of oil shale in a fluid bed. The economics and engineering feasibility of using fluid bed systems to produce hydrogen are examined. Fluid bed processing of oil shale to produce hydrogen might be technically and economically competitive with a more conventional shale retorting/partial oxidation method. A major development program would be required to demonstrate the feasibility of the fluid bed approach. DOE

N81-29268# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PHOTOCONVERSION OF ORGANIC SUBSTRATES INTO HYDROGEN USING PHOTOSYNTHETIC BACTERIA
Paul F. Weaver Mar. 1981 12 p refs Presented at the 5th Ann. IGT Energy from Biomass and Wastes Symp., Lake Buena Vista, Fla., 26-30 Jan. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-623-1073; CONF-810116-3) Avail: NTIS HC A02/MF A01

Under nitrogen limited conditions, photosynthetic bacteria photoconvert a wide variety of organic substrates nearly totally into H2 and CO2. More than 98 percent of the chemical energy of defined organic compounds even from dilute solutions can be recovered as combustible energy of the H2 produced. Not calculating the chemical energy input, radiant (solar) energy recoveries are approximately 5 percent over a wide range of incident light intensities. Batch cultures can photoproduce H2 at rates of 175 ml per gram dry weight of cells per hour when incubated in saturating light. With periodic refeeding, rates remain constant for several weeks. In closed containers H2 pressures of 735 psig can be generated. In principle, this pressure can be used to decrease storage volume of the gas, to move it through pipelines or to provide required process pressures. Alcohol stillage and food processing wastes are excellent photoconvertible substances. DOE

N81-30247# General Electric Co., Wilmington, Mass. Direct Energy Conversion Programs.
SOLID POLYMER ELECTROLYTE WATER ELECTROLYSIS TECHNOLOGY DEVELOPMENT FOR LARGE SCALE HYDROGEN PRODUCTION (DESIGN PHASE) Annual Report
J. H. Russell Nov. 1980 28 p refs Sponsored by the Gas Research Inst.
(PB81-201964; GRI-79/0102) Avail: NTIS HC A03/MF A01 CSCL 07A

The design for a water electrolysis module containing (14) cells each with 10 sq ft active area was completed. This included final drawings for Membrane/electrode assembly, Molded carbon current collector, Fluid plates, and Pneumatic end plates and boiling arrangements. GRA

N81-30279*# Billings Energy Corp., Independence, Mo.
HYDROGEN FROM COAL COST ESTIMATION GUIDEBOOK
Roger E. Billings [1981] 274 p refs Prepared for JPL
(Contracts NAS7-100; JPL-955261)
(NASA-CR-164692; JPL-955-578) Avail: NTIS HC A12/MF A01 CSCL 21D

In an effort to establish baseline information whereby specific projects can be evaluated, a current set of parameters which are typical of coal gasification applications was developed. Using these parameters a computer model allows researchers to interrelate cost components in a sensitivity analysis. The results make possible an approximate estimation of hydrogen energy economics from coal, under a variety of circumstances. T.M.

N81-32316# Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.
THERMAL AND STRUCTURAL DESIGN ASPECTS OF HIGH-TEMPERATURE BLANKETS FOR FUSION SYNFUEL PRODUCTION
J. R. Powell, J. A. Fillo, and M. Reich 1981 10 p refs Presented at the 6th Intern. Conf. on Structural Mech. in Reactor Technol., Paris, 17-21 Aug. 1981
(Contract DE-AC02-76CH-00016)
(BNL-29312; CONF-810801-43) Avail: NTIS HC A02/MF A01

The most promising process, high temperature electrolysis (HTE) of steam at temperatures of > 1000 C is examined. In HTE, a large fraction (up to 50%) of the energy input to split water to hydrogen and oxygen comes from thermal energy. For

the projected operating conditions achieved by high temperature fusion blankets, overall efficiencies for hydrogen production should be on the order of 60%. The design, thermal-hydraulics, and materials for such blankets are discussed. DOE

N81-32318# Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.

HYFIRE 2: A FUSION/SYNFUEL PRODUCER

J. A. Fillo 1981 4 p refs Presented at the 16th IECEC Conf., Atlanta, 9-14 Aug. 1981

(Contract DE-AC02-76CH-00016)

(DE81-023702; CONF-810812-21; BNL-29581) Avail: NTIS HC A02/MF A01

HYFIRE II is a point design study of a commercial fusion Tokamak reactor coupled to a high-temperature electrolysis (HTE) system for the production of hydrogen and oxygen. The purpose of the study is to assess the technical and economic feasibility of the application of fusion energy for the production of these basic fuels. The HYFIRE II fusion reactor design is based on the STARFIRE commercial power reactor, the primary differences are in the type of blankets between the two reactors, th power cycle design and in the increased thermal power rating (to 6000 MW(th)). Based on HYFIRE conceptual design studies to date, the following observations are made: (1) blanket designs have been identified to simultaneously meet global tritum breeding requirements and required energy splits between process steam and helium; (2) attractive tritium breeders such as LiAlO2 and liquid lead with dissolved lithium were identified; and (3) high H2 production efficiencies in the 50 to 55% range appear achievable. DOE

N81-32319# Los Alamos Scientific Lab., N. Mex.

SOLAR-THERMAL HYDROGEN PRODUCTION

Melvin G. Bowman 1981 9 p refs Presented at the Solar Thermal Test Facility (STTF) Workshop on STTF Testing for Long-Term System Performance, Albuquerque, N. Mex., 7-9 Jan. 1981

(Contract W-7405-eng-36)

(LA-UR-81-1730; DE81-025406; CONF-810137-2) Avail: NTIS HC A02/MF A01

Since hydrogen is not only an eventual and attractive fuel but is also a prime intermediate in the production of many fuels and chemicals, one extremely valuable utilization of a solar thermal facility would be its operation as a system for hydrogen production. Such a use would also fulfill the important requirement for energy storage. Solar thermal systems appear to offer the only practical method for significant hydrogen production from solar energy. The production could utilize advanced methods of water electrolysis if highly efficient generation of solar electricity were developed. Thermochemical cycles for water decomposition appear to be more promising if cycles that match the characteristics of solar heat sources can be developed. Advanced cycles based on solid sulfate or solid oxide decomposition reactions should interface advantageously with solar thermal systems. Sulfuric acid cycles can serve as standards of comparison for these new cycles as they are discovered and developed. DOE

N81-32656# Siemens A.G., Erlangen (West Germany). Forschungslab.

TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 5: HYDROGEN PRODUCTION BY STEAM REFORMING OF METHANOL Final Report

Burghard Grave Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 231 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.

(BMFT-FB-T-80-058-Vol-5; ISSN-0340-7608) Avail: NTIS HC A11/MF A01

To assess its potential use in alkaline fuel cells, The production of hydrogen by steam reforming of methanol was studied analytically and experimentally. The reformer, the converter, and the purification system of a prototype installation were designed and the optimal operation parameters derived and experimentally confirmed. For comparison, hydrogen production by ammonia cracking was also studied. An estimate of the manufacturing costs for a fuel cell aggregate of 20 kW indicates economical operation only to be possible at very high duty cycles. As a result the project was terminated. Author (ESA)

N81-33268# National Bureau of Standards, Boulder, Colo. Center for Chemical Engineering.

SELECTED PROPERTIES OF HYDROGEN (ENGINEERING DESIGN DATA) Final Report

R. D. McCarty, J. Hord, ed., and H. M. Roder Feb. 1981 525 p refs

(PB81-211492; NBS-MN-168; LC-80-600195) Avail: NTIS HC A22/MF A01 CSCL 07D

Data on hydrogen properties research are presented. Thermophysical properties of liquid, liquid vapor, vaporous, and gaseous hydrogen are presented and the solid-liquid, solid vapor, and solid phase properties are compiled. Ortho para modifications of the hydrogen molecule and attendant property variations are considered. Combustion and safety data, pertinent to hazard analysis of hydrogen systems, and miscellaneous properties are collected. Data figures, data tables, and symbols, units, and conversion factors are summarized. GRA

04

FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

A81-40847 * # Comparisons of advanced hydrocarbon rocket engines for earth-to-orbit vehicles. J. A. Martin (NASA, Langley Research Center, Space Systems Div., Hampton, VA). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1371.* 13 p. 14 refs.

The Space Shuttle has initiated a new era in earth-to-orbit transportation, and studies are now underway to assess the technology requirements for more advanced vehicles. Potential derivatives of the Space Shuttle and completely new vehicles might both benefit from advanced hydrocarbon engines, several versions of which were recently studied. In the present paper, selected single-stage vehicles have been compared using these engines. The results indicate that propane staged-combustion engines are attractive for this application. The potential effects of advanced engine materials are also shown. (Author)

A81-40867 # Degradation and characterization of antimisting karosene /AMK/. R. J. Mannheimer (Southwest Research Institute, San Antonio, TX). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1423.* 9 p. 8 refs. U.S. Department of Transportation Contract No. FA79WA-4310.

The effect of elongational flow on polymer degradation has been studied by forcing AMK through metal screens and packed tubes at high velocities. At a specific power of 15 kWs/l, AMK exhibits filtration and ignition properties similar to Jet A in small-scale tests. A glycol/amine carrier fluid developed to promote rapid dissolution of FM-9 polymer in Jet A has been found to increase antimisting effectiveness, reduce gel formation and filtration resistance, and require less degrader power. Other fuel-soluble hydrogen bonding agents produce similar effects with FM-9 in Jet A. At low Reynolds numbers, the flow of AMK through metal screens and paper filters is characterized by a critical velocity that depends on polymer degradation, filter material, pore size, and the presence of hydrogen bonding agents. Below this critical velocity, the flow resistance of AMK is determined by the low shear viscosity. At a slightly higher velocity, the flow resistance increases dramatically. While this phenomenon is commonly observed with many polymer solutions, in the case of FM-9 it is also associated with gel formation that may result in filter plugging. However, at very high velocities, gel formation and filter plugging are no longer evident with either metal screens or packed tubes. (Author)

A81-40868 # Acceptability of shale derived fuel for Navy aircraft propulsion systems. P. A. Karpovich and C. J. Nowack (U.S. Naval Air Propulsion Test Center, Trenton, NJ). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1424.* 6 p. 15 refs.

As part of a joint DOD/DOE synthetic fuels program, 100,000 barrels of shale oil crude was produced by the Paraho process and refined into a spectrum of DOD fuels. The JP-5 fraction which is the subject of this paper, was evaluated in the laboratory in component and full-scale engine tests. Findings are compared to results obtained on a shale derived JP-5 produced earlier in a full scale refining program and with petroleum JP-5. Despite some minor deficiencies in fuel chemistry caused by the severe hydrotreatment of the crude the JP-5 fuel was found to be acceptable for Navy aircraft use. (Author)

A81-41342 Gas economy - Gas technology (Gaswirtschaft - Gastechnik). E. Scholand (Bochum, Ruhr-Universität, Bochum, West Germany). *Brennstoff-Wärme-Kraft,* vol. 33, Apr. 1981, p. 134-138. 127 refs. In German.

Economic developments in West Germany concerning fuel gas are examined. It is pointed out that an assured supply of natural gas for West Germany can only be obtained on the basis of prices of a market economy. Internal sources in West Germany provided about 34% of the fuel gas requirements. A contract concerning the import of 2.3 billion cu m liquid natural gas per year was concluded with Nigeria. Attention is given to questions of natural gas production, natural gas reserves, potential sources for importing natural gas, transportation, storage, distribution, consumption of natural gas by industry, installations for measurement and control, environmental protection, and the possibilities for a replacement of natural gas by products of coal gasification processes. G.R.

A81-41343 Regenerative energy sources (Regenerative Energiequellen). M. Meliss (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Brennstoff-Wärme-Kraft,* vol. 33, Apr. 1981, p. 138-145. 66 refs. In German.

The significance of the regenerative energy sources for West Germany is examined, taking into account heat pump installations, solar collectors, water power, wind energy converters, and biomass. It is estimated that between 250,000 and 400,000 heat pumps will be sold per year. Passive systems, low-temperature collector installations, and heat pumps are discussed. Attention is also given to high-temperature collector installations and solar cells, design data for a solar farming installation, the installation of a power station for utilizing wind energy, geothermal energy, wave energy conversion, the utilization of the temperature difference at different depths in sea water, questions of biomass conversion, and firewood. G.R.

A81-41727 Spark-assisted diesel for multifuel capability. K. Komiyama and I. Hashimoto (Komatsu, Ltd., Tokyo, Japan). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810072.* 12 p.

In order to evaluate the feasibility of spark-assisted diesel engine concept for multifuel capability in which forced spark can assist ignition in case of no self-ignition, a spark plug was adapted in the pre-combustion chamber of a conventional diesel engine. And performance tests and emission tests on the engine were carried out with methanol, ethanol, gasoline and diesel fuel. And also injection and combustion characteristics with the fuels were measured for the investigation of difference with each fuel. The test results show that this spark-assisted diesel has multifuel capability and it is concluded that this type of engine has enough potential for the future and alternate low cetane number fuel use and the performance is comparable to a conventional diesel engine with various fuels. (Author)

A81-41800 Biogas: Production and utilization. E. C. Price and P. N. Cheremisinoff (New Jersey Institute of Technology, Newark, NJ). Ann Arbor, MI, Ann Arbor Science Publishers, Inc., 1981. 152 p. 150 refs. $29.95.

Among the aspects of biogas production and utilization covered are: (1) the microbiology and biochemistry of the acid and methane production stages in the anaerobic process; (2) factors affecting the process, such as temperature, acidity and alkalinity, nutrients, and cations; (3) denitrification processes and systems; and (4) the process kinetics of suspended growth systems, packed columns, and fluidized beds. Also considered are such issues in the application of this technology as the digestion of municipal treatment plant sludges, animal wastes, food processing wastes and energy crops. Attention is in addition given to anaerobic digester design, offgas measurement of anaerobic digesters, and sludge treatment through soil conditioning and composting. O.C.

A81-42276 # The use of imagery of the earth to study the structure of degassing zones within oil and gas basins (Ispol'zovanie kosmicheskikh snimkov zemli pri izuchenii stroeniia zon degazatsii neftegazonosnykh basseinov). G. I. Amurskii and M. S. Bondareva (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Prirodnykh Gazov, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 5-10. 6 refs. In Russian.

Space imagery is used to identify and trace the local faults and fracture zones of several anticlinal structures in Central Asia. These zones, favorable to the vertical migration of stratified fluids, exhibit an increased permeability, and are therefore subject to degassing and the accumulation of gaseous sulfur. J.F.

A81-42496 # Experiments on a hurricane windmill model. V. W. Bolie (New Mexico, University, Albuquerque, NM). *Journal of*

Energy, vol. 5, July-Aug. 1981, p. 250, 251. 5 refs.

Airflow tests of a vertical-axis wind turbine model were performed to establish accurate endpoints for the curve of trans-rotor pressure vs trans-rotor flow rate. Calibrated free-field flow tests at wind speeds up to 25 m/s, and corroborating experiments using tufted-yarn flow tracers were performed, with the latter showing smoother flows at higher wind speeds. The rotor was also replaced by a close-fitting weighted solid disk to measure maximum available trans-orifice pressure drop. Results indicate that the vertical-axis turbines are superior in terms of simplicity, TV interference, and safety enclosed rotor blades, while producing the same amount of power as conventional windmills. Economically, however, the design would not be competitive in terms of dollars/kW/yr. D.L.G.

A81-42676 A comparative study of wind characteristics from different time periods. T. N. Goh and G. K. Nathan (National University of Singapore, Singapore). *Wind Engineering*, vol. 5, no. 2, 1981, p. 60-65. 7 refs.

Time-series modeling of wind data is used to examine the consistency of wind speed characteristics at two stations in Singapore for two periods: 1973, when highrise buildings started to emerge in the area surrounding one of the stations, and 1979, when highrise construction was almost completed. Possible changes in wind speed dynamics are inferred from the model changes and the results of the study are used in deciding whether past data from a given station are suitable for use in the future. It is concluded that past data should not be used in future studies, as changes in wind characteristics have occurred. The use of stochastic modelling as a regular means of monitoring wind characteristics is suggested. K.S.

A81-42677 Estimation of time series models for horizontal wind on the Norwegian west coast. K. J. Eidsvik (Norsk Institutt for Luftforskning, Lillestrom, Norway). *Wind Engineering*, vol. 5, no. 2, 1981, p. 66-72. 10 refs. Research supported by the Norwegian Institute for Energy Technology, Norwegian Statoil Co., and Norsk Hydro.

A time-series model of horizontal wind, sampled at 5 min intervals by automatic weather stations on the Norwegian west coast, is analyzed in order to estimate some characteristics of the stochastic wind variations, relevant to wind energy systems. Power spectra are estimated by fitting autoregressive models to the data, and Akaide's (1974) identification procedure is used. It is shown that low frequency energy dominates the power spectrum, especially during the winter. The minimum 5-min wind prediction error appears to vary more with the spectral intensity at lower frequencies than with the season. K.S.

A81-42678 Wind tunnel tests of sailwings for Darrieus rotors. P. S. Revell and K. W. Everitt (Warwick, University, Coventry, England). *Wind Engineering*, vol. 5, no. 2, 1981, p. 73-90. 5 refs.

Wind tunnel tests have been made to investigate the aerodynamics of sailwings intended for use in vertical axis wind turbines. The tests were made over the full range of angles of incidence and used a number of different membranes and pre-tensions. The majority of tests used a rigid trailing edge but a limited number of tests was made using a wire or nylon cord in a circular-arc shaped trailing-edge. The tangential and radial force coefficients were measured as also was the chordwise component of membrane tension. It is concluded that such turbines should produce a high starting torque and that their performance will be influenced by the trailing edge elasticity and pre-tension at quite low tip speed ratios. (Author)

A81-42679 Comparison of height extrapolation models and sensitivity analysis. A. S. Mikhail (Solar Energy Research Institute, Golden, CO) and C. G. Justus (Georgia Institute of Technology, Atlanta, GA). *Wind Engineering*, vol. 5, no. 2, 1981, p. 91-107. 19 refs.

With wind energy applications in mind, different techniques for wind speed height extrapolation are briefly reviewed, including similarity, power law, modified power law, 1/7 power law, logarithmic, and linear models. Meteorological tower data from Kennedy, Argonne, and nine nuclear power plant sites are used to compare the similarity model with the modified power law model. The analysis shows that the largest deviation between the two models occurs at low wind speeds and in very stable conditions. The sensitivity of the similarity model and the modified power law model to different input parameters is examined, and it is shown that for higher values of wind speeds (which would be of interest in wind energy application), both models are less sensitive to variation in wind speed and stability. Data from sites selected as candidates for installation of large DoE wind turbines are used to test and compare the modified power law model with the other widely used empirical models. K.S.

A81-42680 Wind power prospecting using aerial reconnaissance. J. E. Wade, R. W. Baker, P. A. Maule (Oregon State University, Corvallis, OR), and N. Butler (Bonneville Power Administration, Portland, OR). *Wind Engineering*, vol. 5, no. 2, 1981, p. 108-114. Research supported by the Bonneville Power Administration.

Results are reported for jet ranger helicopter aerial surveys, used for rapidly identifying locations with good wind power potential. An area of approximately 8500 sq km was covered in two one-day surveys; six good locations were noted in the Columbia River Gorge, and three in northeast Washington, based on wind-deformed trees. The procedures used are described, and surface and upper air data of the regions surveyed are indicated. Conclusions are presented including the following: the degree and direction of tree deformation can be easily discerned from a low-flying helicopter, and areas of wind-deformed trees can be used as a screening tool for identifying locations with strong persistent winds. Oblique-angle air photos seem to provide the best documentation of tree deformation. Data obtained can be used by utilities seeking information on where to focus efforts in wind power site evaluation, and by government agencies seeking a potential wind source evaluation to be incorporated into comprehensive energy and land use plans. K.S.

A81-42681 A simple model for the probability distribution of wind power with applications to large scale electricity generation. J. Haslett (Trinity College, Dublin, Ireland) and J. Carlin (Commonwealth Scientific and Industrial Research Organization, Div. of Mathematics and Statistics, Canberra, Australia). *Wind Engineering*, vol. 5, no. 2, 1981, p. 115-132. 12 refs. Research supported by the National Energy Research, Development and Demonstration Council of Australia.

A very simple model is presented for the distribution of wind power, the parameters of which could be determined from simple wind speed and power-velocity models, even in case of multiple site applications. It is shown how the model can be used together with data on the distribution of the load or demand for electricity to compute the distribution of the residual load placed on a conventional plant, when wind power is introduced into the grid. Applications of the model are presented. K.S.

A81-42906 Separation of hydrogen isotopes with uranium hydride. S. Imoto, T. Tanabe, and K. Utsunomiya (Osaka University, Suita, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 909-916. 10 refs.

The isotope effect on the decomposition behavior of uranium hydride is examined, since the separation of hydrogen isotopes is one of the most important processes in fission and fusion power generating systems. The decomposition equilibrium pressure is measured for UH3, UD3, and UH(1.5)D(1.5) in the temperature range of 500-700 K; the decomposition pressure of UD3 is higher than that of UH3, and UH(1.5)D(1.5) shows an intermediate decomposition pressure. The enthalpy and entropy formations are obtained and they are in good agreement with those determined by a calorimetric study. When the reaction reaches the point of equilibrium, deuterium is enriched in the gas phase, and the separation factor is approximately 1.3. Experiments on deuterium enrichment, made with a small cascade, also show a separation factor of about 1.3. A thermodynamic model for the case where the mixed hydride is the regular solution, is used, and it is shown that the separation factor is larger for gas mixtures with a high D/H ratio at higher temperatures and for those with a low D/H ratio at lower temperatures. K.S.

A81-43048 Producer gas engines in villages of less-developed countries. R. Datta (Exxon Research and Engineering Co., Linden, NJ) and G. S. Dutt (Princeton University, Princeton, NJ). *Science*, vol. 213, Aug. 14, 1981, p. 731-736. 38 refs.

It is argued that producer gas engines may be able to play an

important role in the near term in the decentralized production of mechanical energy in the rural areas of less-developed countries (LDCs). The producer gas engine system incorporates a solid biomass gasifier, gas cooler, gas cleaner, and ordinary internal combustion engine. The technology, which was first introduced in the 1930s, is capable of 20-30% efficiency (by contrast to less than 10% for steam engines powered by comparable fuels) and can operate on wood, bagasse, straw, and charcoal. Attention is given such issues as gasifier design, fuel processing, energy efficiency and gasification chemistry. A detailed comparison with other renewable resource-based mechanical energy alternatives pertinent to the LDCs is presented. O.C.

A81-43248 Satellite observations of a geothermal submarine spring off Florida west coast. F. A. Kohout (U.S. Geological Survey, Woods Hole, MA), R. C. Munson (NOAA, Norfolk, VA), R. M. Turner (U.S. Geological Survey, Reston, VA), and W. R. Royal. In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 570-578. 20 refs.

A81-43521 # Using liquid fuels at low temperatures /3rd revised and enlarged edition/ (Primenenie zhidkikh topliv pri nizkikh temperaturakh /3rd revised and enlarged edition/). B. A. Englin. Moscow, Izdatel'stvo Khimiia, 1980. 208 p. 228 refs. In Russian.

The properties of liquid fuels revealed during use at low temperatures in aircraft, motor vehicles, diesels, furnaces, gas turbines, motors, and boilers are presented. The changes to which the fuels are subjected under these conditions are described, as are the measures to be taken in avoiding the complications that arise from use at low temperatures. C.R.

A81-44336 * Applications of polymer extrusion technology to coal processing. D. W. Lewis (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981. Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 125-131. 5 refs. Research sponsored by the U.S. Department of Energy and NASA.

Upon heating, many of the middle-aged bituminous coals exhibit a plasticity very similar to polyethylene for a few minutes. Plastic coal can be extruded, pelletized or molded using common plastics technology and equipment. Investigations concerning the plastic state of coals are conducted with the objective to develop techniques which will make useful commercial applications of this property possible. Experiments which show the characteristics of plastic-state coal are discussed, and problems related to a continuous extrusion of coal are considered. Probably the most significant difference between the continuous extrusion of coal and the extrusion of a thermoplastic polymer is that volatiles are continuously being released from the coal. Attention is given to aspects of dragflow, solids feeding, and melt pumping. Application potentials for plastic coal extrusion might be related to coal gasification, direct liquefaction, and coal combustion. G.R.

A81-44433 Hot dry rock geothermal energy. G. Heiken, H. Murphy, G. Nunz, and R. Potter (California, University, Los Alamos, NM). *American Scientist*, vol. 69, July-Aug. 1981, p. 400-407. 31 refs.

Man-made geothermal systems are discussed which make it possible to extract heat from hot rocks in areas where natural fluids are insufficient for the development of hydrothermal energy. The location and magnitude of high- and low-temperature geothermal resources in the USA for such hot dry rock (HDR) systems are examined. An HDR concept is described in which water is injected into one of two nearly parallel wells connected at depth by man-made fractures; the injected water circulates through the fracture system, where it is heated by conduction from the hot rock, and hot fluid, which can be used for heating or for electric power generation, rises through the second well. Some heat-extraction experiments using the described concept are reviewed which are being conducted in a complex volcanic field in New Mexico. The economics of HDR energy is evaluated. F.G.M.

A81-44494 # Energy extraction from fractured geothermal reservoirs in low-permeability crystalline rock. H. D. Murphy, J. W. Tester, C. O. Grigsby, and R. M. Potter (California, University, Los Alamos, NM). *Journal of Geophysical Research*, vol. 86, Aug. 10, 1981, p. 7145-7158. 33 refs. Research supported by the U.S. Department of Energy.

The thermal performance and flow characteristics of two hot dry rock geothermal energy reservoirs created by the hydraulic fracturing of granitic rock are discussed. The reservoirs were produced by fracturing an injection well at a depth of 2.75 km and again 180 m deeper (rock temperature 185 C) on the west bank of the Valles Caldera, a dormant volcanic complex in northern New Mexico. Heat was extracted in a closed-loop operation by the injection of water into one well and the extraction of heated water from a separate well. Results of temperature measurements and thermal modeling for the first reservoir over an initial 75-day test period indicate a thermal exchange area of 8000 sq m, and coupled with flow rate surveys suggest an effective fracture radius of about 60 m with an average thermal power extracted of 4 MW. Evaluation of the second reservoir during a 32-day flow test indicates an effective heat transfer area of at least 45,000 sq m, and a mean reservoir volume nine times greater than that of the first reservoir. Further measurements have shown low flow impedances and downhole water losses for both reservoirs, with produced water of good quality and little insignificant induced seismic activity. A.L.W.

A81-44593 # The influence of pressure on the evaporation dynamics of a drop of fuel (O vlianii davleniia na dinamiku isparenia kapli topliva). O. N. Lebedev and V. N. Marchenko (Novosibirskii Institut Inzhenerov Vodnogo Transporta, Novosibirsk, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk*, June 1981, p. 12-15. 13 refs. In Russian.

Features of the phase transitions in the 'supercritical' region are considered for liquid fuel. The intensification that has been detected in the evaporation of a drop with an increase in the pressure of the surrounding gas is explained in physical terms. Analytic relationships characterizing the dynamics of drop evaporation are verified using extensive experimental data. In addition, the applicability of the quasi-equilibrium diffusion theory to the supercritical evaporation of fuel is corroborated. C.R.

A81-45234 * Molecular carbon isotopic evidence for the origin of geothermal hydrocarbons. D. J. Des Marais (NASA, Ames Research Center, Moffett Field, CA), J. H. Donchin, N. L. Nehring, and A. H. Truesdell (U.S. Geological Survey, Menlo Park, CA). *Nature*, vol. 292, Aug. 27, 1981, p. 826-828. 16 refs.

Isotopic measurements of individual geothermal hydrocarbons that are, as a group, of higher molecular weight than methane are reported. It is believed in light of this data that the principal source of hydrocarbons in four geothermal areas in western North America is the thermal decomposition of sedimentary or groundwater organic matter. O.C.

A81-45486 Lateral coherence of longitudinal wind components in strong winds. L. Kristensen (Forsogsanlaeg, Roskilde, Denmark), H. A. Panofsky (Pennsylvania State University, University Park, PA), and S. D. Smith (Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada). *Boundary-Layer Meteorology*, vol. 21, Sept. 1981, p. 199-205. 6 refs.

It is pointed out that the lateral coherence of wind speed has important applications to engineering problems, involving such systems as bridges, power lines, and windmills. The considered study has the objective to bring data concerning lateral coherence together and to devise a scheme from which lateral coherence of wind speed (for the longitudinal component of wind velocity) in strong winds (neutral stability) can be estimated. Theoretical aspects regarding the considered concepts are examined, taking into account the definition of coherence, the analysis of measurements of coherence in terms of 'Davenport similarity', and measurements in anisotropic turbulence occurring for example in the atmospheric surface layer. Attention is given to the test of a hypothesis reported by Kristensen and Jensen (1979), observations by Smith (1972), a recommended line for estimating the decay constant, and the 'elongation factor'. G.R.

A81-46250 Turbulent gaseous combustion. I - Local species concentration measurements. M. H. Lewis and L. D. Smoot

(Brigham Young University, Provo, UT). *Combustion and Flame*, vol. 42, Aug. 1981, p. 183-196. 16 refs. Research supported by the Electric Power Research Institute and Brigham Young University.

Experimental measurements were made of fuel mixture fraction profiles and species concentration profiles (C2, N2, CH4, CO, CO2, H2O, and tracer Ar) in turbulent natural gas diffusion flames. Twenty-eight tests were performed in an axisymmetric combustor with coaxial feed of fuel and air. The test variables included type and arrangement of sample probe, combustor wall temperature, and air feed temperature. Gas samples were obtained with both water-quench and water-cooled probes. Direct water-quench probes were more effective in quenching reactions inside the sampling probe than water-cooled probes; however, some of the CO2 in the gas samples was dissolved in the quench water. A 350 K change in the wall temperature had a negligible effect on gas mixing rates, but did alter the local gas species distributions somewhat. More complete combustion was achieved with elevated air feed temperatures, but more complete mixing was obtained at lower air temperatures. The results provide a data base for evaluating predictive computer models.

(Author)

A81-46461 First Shuttle payload loading to begin. C. Covault. *Aviation Week and Space Technology*, vol. 114, June 29, 1981, p. 54, 55, 57, 59.

The first Office of Space and Terrestrial Applications (OSTA 1) Space Shuttle payload, a multi-instrument array aimed at the development of oil and mineral exploration from space, will be carried into orbit by the second Columbia Orbiter mission. The Spacelab pallet mounting of the package incorporates: (1) the Shuttle imaging radar (SIR-A), which will study geological formations; (2) the Shuttle multispectral infrared radiometer; (3) a feature identification and location experiment; (4) an ocean color experiment; and (5) an air pollution measurement-from-satellite experiment. In one of the two OSTA 1 experiments to be conducted from the Shuttle cabin, photographic studies will be made of lightning propagation across thunderstorms. O.C.

A81-46473 Biomass production and bioconversion to both fuel and food employing solar energy technology - An alternative to conventional farming and the conversion of food to fuel. D. L. Wise (Dynatech R/D Co., Cambridge, MA). *Solar Energy*, vol. 27, no. 2, 1981, p. 159-178. 137 refs.

A process for the bioconversion of high-yield biomass to both fuel and food, judged more efficient than the conventional production of soybean meal and methanol, is described. Attention is given the diversion of farm land for the production of a conventional food/energy crop, such as corn, that will be subsequently converted to a liquid fuel. The technique presented involves growing biomass at optimum crop yield, then converting it to synthesis gas and finally, through bioconversion, to single-cell protein and methanol. Background for the various aspects of the system and its preliminary engineering economics are provided. O.C.

A81-47250 Wind prevailing in German coastal regions (Das regionale Windangebot an den Deutschen Küsten). G. Duensing (Deutscher Wetterdienst, Seewetteramt, Hamburg, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 441-449. In German.

Data from the Deutscher Wetterdienst were used to evaluate the wind energy potential of the German coast. A marked reduction of the strong winds prevailing over the sea as they move inland was noted from the medium wind velocity chart. It follows that only the immediate coastal areas of the North Sea and the Isle of Fehmarn will allow an optimal utilization of wind forces. A direct correlation between wind values and area suggests that an efficient compound system of wind energy converters should be installed, widely spaced, in that particular area. Structures should be able to withstand gust loads of at least 50 m/s in the coastal areas. B.J.

A81-47363 Ore-controlling space geological objects and their assessment techniques applied to mineral prediction. A. L. Stavtsev (Ministerstvo Geologii SSSR, Ob'edinenie Aerogeologiia, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-107*. 4 p.

The importance of rupture dislocations is assessed, and it is noted that faults and fault zones are commonly well exhibited on space images. The combined analysis of fault identification charts and maps of the distribution of known mineral deposits makes it possible to assess the role of rupture dislocations in the spatial distribution of minerals and to delineate, through analogy, promising areas for mineral extraction. Attention is also given to the analysis of the ore-controlling importance of ring structures and to the combined application of identified space images and geological and geophysical data to a computerized mineral prediction. It is concluded that the application of space images to mineral exploration provides geologists with ample opportunity for studying the spatial distribution of metallic and nonmetallic ores and predicting their potential occurrences. C.R.

A81-47502 Resource recovery today and tomorrow; Proceedings of the Ninth Biennial National Waste Processing Conference, Washington, DC, May 11-14, 1980. Conference sponsored by the American Society of Mechanical Engineers. New York, American Society of Mechanical Engineers, 1980. 632 p. Members, $80.; nonmembers, $100.

Among the topics discussed are the opportunities and problems of energy recovery from solid wastes, an approach to burning refuse as a powerplant fuel, a technical evaluation of modular incinerators with heat recovery, the incineration of hazardous organic wastes, resource recovery through composting, the performance and testing of a ferrous metals recovery system, and the production of paper pulps from municipal solid waste. Also considered are a comprehensive municipal refuse characterization program, life cycle costing for resource recovery facilities, the prediction and testing of incinerator and boiler efficiency, the performance of zig zag classifiers at low particle concentrations, the biogasification of municipal solid wastes, and operations reports from municipal resource recovery programs. Attention is in addition given such pollution control issues as dry system and waterborne emission control technologies. O.C.

A81-47507 Reaction engineering in direct coal liquefaction. Edited by Y. T. Shah (Pittsburgh, University, Pittsburgh, PA). Reading, MA, Addison-Wesley Publishing Co. (Energy Science and Technology, No. 3), 1981. 411 p. $47.50.

Processes for direct coal liquefaction by solvent extraction are considered along with the structure and properties of coal and the mechanism of coal liquefaction, heteroatom removal during liquefaction, kinetic models for donor-solvent coal liquefaction, the design of coal liquefaction reactors, and the refining of coal liquids. Attention is given to the catalytic hydrogenation of coal in the presence of a solvent, the origin and character of coal, laboratory reactors for rate measurements, reaction networks based on lumped fractions, free-radical reaction models, reactor types, the compatibility of coal-derived liquids and petroleum fuels, the stability of coal liquids, thermal cracking, catalytic hydrotreating, catalytic cracking, and catalytic reforming. G.R.

A81-47511 Chemical power sources. V. S. Bagotskii and A. M. Skundin (Akademiia Nauk SSSR, Institut Elektrokhimii, Moscow, USSR). London and New York, Academic Press, 1980. 404 p. 112 refs. Translation. $64.50.

The working principles of chemical power sources are considered along with cell types, aspects of cell performance, the electrochemical aspects of cell operation, the porous systems used for real electrodes, questions of design and technology, operational problems, and applications of cells. Various cell systems are discussed, taking into account manganese-zinc cells with salt solution electrolyte, lead acid storage cells, nickel-cadmium and nickel-iron cells, alkaline cells with zinc anodes, compound cells, cells with nonaqueous solutions, cells with solid and molten electrolytes, and fuel cells. Attention is given to the use of magnesium and aluminum in chemical power sources, manganese-magnesium cells, water-activated reserve cells with magnesium anodes, chemical power sources with organic reactants, cells with PbO2 electrodes, standard cells, air (oxygen) electrodes, air-metal cells, nickel-hydrogen storage cells, chlorine-zinc storage cells, and lithium cells with aqueous electrolyte. G.R.

A81-47738 # Chemical kinetics in LNG detonations. C. K. Westbrook and L. C. Haselman (California, University, Livermore,

CA). In: Gasdynamics of detonations and explosions; International Colloquium on Gasdynamics of Explosions and Reactive Systems, 7th, Göttingen, West Germany, August 20-24, 1979, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 193-206. 11 refs. Contract No. W-7405-eng-48.

The problem of detonability of vaporized mixtures of liquified natural gas and air is addressed, using a characteristic time analysis. Separate numerical models are used to treat the evolution of the blast wave produced by a charge of high explosive and the chemical ignition delay of the fuel-air mixture. These models are combined with experimental data to predict the amount of high explosive required to initiate a detonation of a stoichiometric mixture of methane and air, giving an estimate of 50-100 kg of high explosive in spherical geometry. The effects of minor constituents such as ethane and propane on methane-air detonability are examined, and the mechanism by which these minor constituents kinetically sensitize the fuel is discussed. (Author)

A81-47896 * **Continental rifting - Progress and outlook.** B. H. Baker (Oregon, University, Eugene, OR) and P. Morgan (Lunar and Planetary Institute, Houston, TX). *EOS*, vol. 62, July 21, 1981, p. 585-587. 8 refs.

It is noted that in spite of the flood of new data on continental rifts in the last 15 years, there is little consensus about the basic mechanisms and causes of rifting. The remarkable similarities in rift cross sections (shown in a figure), are considered to suggest that the anomalous lithospheric structure of rifts is more dependent on lithosphere properties than the mode of rifting. It is thought that there is a spectrum of rifting processes for which two fundamental mechanisms can be postulated: an active mechanism, whereby thermal energy is transmitted into the lithosphere from the underlying asthenosphere, and a passive mechanism by which mechanical energy is transmitted laterally through the lithosphere as a consequence of plate interactions at a distance. In order to permit the concept of the two fundamentally different mechanisms to be tested, a tentative classification is proposed that divides rifts into two basic categories: active rifting and passive rifting. Here, the magnitude of active rifting will depend on the rate at which lithosphere moves over the thermal source, with rifts being restricted to stationary or slow-moving plates. C.R.

A81-48022 # **An assessment of wind energy as an alternative energy resource in Malaysia.** F. F. Ling, J. Seah, and C. P. Tai (Malaya, University, Kuala Lumpur, Malaysia). *Regional Journal of Energy, Heat and Mass Transfer*, vol. 3, Apr. 1981, p. 81-96.

The paper investigates the prospect of wind power in the East Coast of Peninsular Malaysia based on wind statistics from meteorological stations at Mersing, Kuantan, Kota Bharu and Kuala Trengganu. From these data, the frequency, wind direction and velocity over a prolonged period are determined. The velocity and power duration curves are drawn and the power outputs are estimated for a 3.66m (12 ft) diameter wind propeller. (Author)

A81-48118 **The chemistry and technology of synthetic fuels.** A. Schriesheim and I. Kirshenbaum (Exxon Research and Engineering Co., Florham Park, NJ). *American Scientist*, vol. 69, Sept.-Oct. 1981, p. 536-542. 37 refs.

The variety of methods by which crude oil residua, coal and oil shale may be converted to synthetic fuels are considered, with attention to the chemical conversion processes that must be implemented on a large industrial scale. Among the technologies highlighted are (1) Flexicoking, in which residuum, preheated to 300 C, is sprayed into a reactor containing a fluidized solids bed of hot coke; the resulting thermal cracking of the residuum at 525 C forming gaseous and liquid products for conventional processing; (2) coal pyrolysis, a carbon rejection process that produces liquids, tars and coke; (3) hydroliquefaction, in which coal is liquefied directly by treatment with hydrogen at 450 C and pressures in the 70-200 atmospheres range; and (4) oil shale retorting, which is seen as requiring considerable further development before commercial feasibility is reached. O.C.

A81-48174 **Energy, the biomass options.** H. R. Bungay (Rensselaer Polytechnic Institute, Troy, NY). New York, Wiley-Interscience, 1981. 357 p. 383 refs. $29.95.

A critical survey of the production of fuels and chemicals from plant materials is presented. Critical evaluations of processes in use and options available for biomass are given along with recommendations concerning these options. Prospects for energy and chemicals from biomass are analyzed in terms of feedstocks, conversion processes, and the consequences of new technology. Particular consideration is given to such processes as thermochemical methods, anaerobic digestion, fractionation and pretreatment, fermentation, and photobiological processes. Cost and environmental factors are discussed. B.J.

A81-48316 # **Possibilities of using wind power in Hungary.** M. Blaho (Budapesti Muszaki Egyetem, Budapest, Hungary). *Periodica Polytechnica, Mechanical Engineering*, vol. 25, no. 1, 1981, p. 57-65.

A81-48318 # **Complex energetic utilization of high-CO2 natural gases.** G. Veres (Budapesti Muszaki Egyetem, Budapest, Hungary). *Periodica Polytechnica, Mechanical Engineering*, vol. 25, no. 1, 1981, p. 87-92.

A81-48319 # **Geothermal energy in Hungary.** F. Pikler (State Office of Technical Development, Budapest, Hungary). *Periodica Polytechnica, Mechanical Engineering*, vol. 25, no. 1, 1981, p. 93-98.

A81-48386 **Modeling the exploitation of thin geothermal reservoirs.** H. Rubin and S. Bachu (Technion - Israel Institute of Technology, Haifa, Israel). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 503-506.

Modeling the exploitation of thin geothermal reservoirs is achieved through three phases: (a) The bulk model approach which considers that the reservoir consists of a solid and liquid fractions having identical temperatures through the whole reservoir, (b) The one dimensional model approach which assumes that the reservoir consists of a thin saturated porous layer, bounded by thin impermeable layers. This approach neglects the effect of temperature variations in the vertical direction but takes into account heat transfer between the impermeable and porous layers, which leads to temperature variations in the horizontal direction, (c) The two dimensional model approach which takes into account temperature variations in the horizontal as well as vertical directions. Advantages and possible applications of each one of these approaches are considered in this article. (Author)

A81-48428 **Correlation of crude oils with their oil source formation, using high resolution GLC C6-C7 component analyses.** G. T. Philippi. *Geochimica et Cosmochimica Acta*, vol. 45, Sept. 1981, p. 1495-1513. 19 refs.

A novel method based on high resolution gas liquid chromatography (GLC) component analyses of shale and crude oil C6-C7 hydrocarbons is reported, by means of which the composition parameters in an oil are compared with the corresponding parameters in a shale. A similarity coefficient has been devised to measure the degree of correlation between crude oil and source rock hydrocarbons and between the hydrocarbons from different groups of crude oils, having 1.00 as its theoretical maximum value and a fraction close to zero as its minimum. With values above 0.80, correlation between the given hydrocarbons is considered good, and poor below 0.73. It has been found that erroneous crude oil-source rock combinations from areas with more than one source formation have low similarity coefficients, indicating that the correlation method proposed is functioning properly. O.C.

A81-48432 * **Thermal alteration of Cretaceous black shale by diabase intrusions in the eastern Atlantic. II - Effects on bitumen and kerogen.** B. R. T. Simoneit, S. Brenner, K. E. Peters, and I. R. Kaplan (California, University, Los Angeles, CA). *Geochimica et Cosmochimica Acta*, vol. 45, Sept. 1981, p. 1581-1602. 67 refs. Contract No. EY-76-3-03-0034; Grant No. NGR-05-007-221.

A81-48584 **Instability of parallel thermal cracks and its consequences for hot-dry rock geothermal energy.** Z. P. Bazant (Northwestern University, Evanston, IL). In: Thermal stresses in

severe environments; Proceedings of the International Conference on Thermal Stresses in Materials and Structures in Severe Thermal Environments, Blacksburg, VA, March 19-21, 1980.

New York and London, Plenum Press, 1980, p. 169-181. 14 refs. Research supported by the U.S. Department of Energy; NSF Grants No. AER-75-00187; No. ENG-75-14848-A01.

A review is conducted of recent work on instabilities of crack systems and applications to the hot-dry rock geothermal energy scheme. An outline is presented concerning the basic variational formulation of the crack stability problem, and the critical states of a system of parallel equidistant cooling cracks propagating into a halfspace are analyzed. The obtained solution is important for cases involving the withdrawal of heat from hot rock by circulation of water in cooling cracks. Some typical numerical results obtained by the finite element method are presented, and the effect of the temperature drop profile on the critical crack length is discussed. Other applications considered are related to parallel cooling cracks or drying shrinkage cracks in reinforced solids, such as concrete. G.R.

A81-48585 Thermal stresses in coal conversion pressure vessels built of layered construction. T. R. Tauchert (Kentucky, University, Lexington, KY). In: Thermal stresses in severe environments; Proceedings of the International Conference on Thermal Stresses in Materials and Structures in Severe Thermal Environments, Blacksburg, VA, March 19-21, 1980.

New York and London, Plenum Press, 1980, p. 183-205. 12 refs. Contract No. DE-AS05-77ET-05378.

An investigation is conducted of radially varying temperature and thermal stress distributions in layered pressure vessels designed for use in coal conversion processes. A least-squares residual method which incorporates Lagrange multipliers for satisfaction of initial, boundary, and interface conditions is employed in the case of transient heat conduction. Assuming orthotropic elastic behavior, a general solution is formulated for the stresses induced by combined temperature, pressures, and initial interferences between layers. The effects of heat-transfer resistance at layer contact surfaces are illustrated through several numerical examples. Attention is also given to the representation of a layered vessel as a homogeneous cylinder having an effective thermal conductivity. G.R.

A81-48684 # The use of satellite imagery for studying the structural features of the Caspian oil and gas region (Primenenie kosmicheskikh materialov dlia izucheniia strukturnykh osobennostei pri-Kaspiiskoi neftegazonosnoi provintsii). L. F. Volchegurskii and V. G. Pronin (Vsesoiuznoe Aerogeologicheskoe Nauchno-Proizvodstvennoe Ob'edinenie Aerogeologiia, Moscow, USSR). *Issledovanie Zemli iz Kosmosa*, July-Aug. 1981, p. 32-38. 8 refs. In Russian.

Based on a study of satellite imagery, the boundaries of the Caspian oil and gas region are defined, and the linear structures, interpreted as faults or zones of faults, are distinguished. Ring structures, corresponding to the structures of the different horizons of the sedimentary cover and bedplate, are discussed. Based on the data obtained by satellite imagery, a detailed scheme of the oil and gas geological regionalization is presented. Such a study is then used to define the individual oil and gas zones within the range of the Caspian region, to trace the extended faults which play a significant role in forming these oil and gas zones, to select regions of seismic research, and to reinterpret the structural maps. J.F.

A81-48685 # The interrelation of linear and isometric objects on satellite imagery and the oil and gas structures of the Buzuluk Basin (O vzaimosviazi lineinykh i izometrichnykh ob'ektov na kosmicheskikh snimkakh i neftegazonosnykh struktur Buzulukskoi vpadiny). D. M. Trofimov and B. I. Dmitrieva (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Issledovanie Zemli iz Kosmosa*, July-Aug. 1981, p. 39-44. 5 refs. In Russian.

A81-48936 Remote sensing in development. C. K. Paul (U.S. Agency for International Development, Washington, DC) and A. C. Mascarenhas (Dar es Salaam, University, Dar es Salaam, Tanzania). *Science*, vol. 214, Oct. 9, 1981, p. 139-145. 12 refs.

It is pointed out that in developing countries remote sensing is used to acquire statistics on crops and to locate petroleum and mineral deposits. To an ever greater extent, it is also being used for forest monitoring and subsurface water location. Among the problems related to Third World use of the technology are sensitivity about the dissemination of data with high spatial resolution, exploitation by multinational companies, absorptive capacity of countries for advanced technology, autonomy in acquiring resource information, and competing foreign policy interest of the industrialized world in the global search for raw materials. The attitude of Third World countries toward the use of remote sensing is seen as depending on the development model they adopt. C.R.

A81-49161 # Propulsion energy for tomorrow's aviation (Antriebsenergie für die Luftfahrt von morgen). V. M. Akimov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motorostroeniia, Moscow, USSR). *(Grazhdanskaia Aviatsiia*, no. 2, 1980.) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol. 17, no. 2, 1981, p. 68-71. In German. (Translation).

One of the objectives of the Central Institute for the Construction of Aircraft Engines in the USSR involves the study of the characteristics for the aircraft propulsion system to be used at the end of the 20th and the beginning of the 21st century. Conclusions reached in this study are discussed. Further improvements in the efficiency of new propulsion units will be possible on the basis of a high bypass ratio and better operational parameter values. It is pointed out that the design of engines of the new generation will require the solution of complex problems concerning gas dynamics, cooling, and materials. The efficiency of turbine and compressor must be further enhanced and the space remaining between moving and stationary parts in compressor and turbine must be reduced. It is expected that, as a result of these steps, it will be possible to obtain a further reduction in fuel consumption by about 10 to 12%. Attention is also given to approaches for increasing the production of aircraft fuels on a hydrocarbon basis, and possibilities for an employment of hydrogen as aircraft fuel. G.R.

A81-49451 Biogas and alcohol fuels production; Proceedings of the Seminar on Biomass, Energy for City, Farm, and Industry, Chicago, IL, October 25, 26, 1979. Edited by J. Goldstein. Emmaus, PA, JG Press, 1980. 246 p. $35.

Basic principles of anaerobic digestion are considered along with the status of the Imperial Valley Biogas Project, the Department of Energy program for the recovery of energy and materials from urban waste, the principles of alcohol production from wastes, the mechanical recovery of a refuse-derived cellulosic feedstock for ethanol production, and the production of ethanol from cellulosic biomass. Attention is given to on-farm alcohol fuel production, the current status and future role of gasohol production, methane generation from small scale farms, farmsite installations of energy harvester anaerobic digesters, biogas/composting and landfill recovery, farm-scale composting as an option to anaerobic digestion, designing a high-quality biogas system, and methane as fuel of the future. A description is presented of subjects which are related to landfill gas recovery, biogas purification with permselective membranes, and anaerobic digestion of marine biomass. Other topics studied include the application of biogas technology in India, biogas production in China, biogasification of organic wastes in the Republic of the Philippines, and economics and operational experience of full-scale anaerobic dairy manure digester. G.R.

A81-49452 Gasohol sourcebook - Literature survey and abstracts. Edited by N. P. Cheremisinoff and P. N. Cheremisinoff. Ann Arbor, MI, Ann Arbor Science Publishers, Inc., 1981. 223 p. $30.

A review is provided of biomass and bioconversion technology literature, giving particular attention to gasohol and related fuels. Literature cited and reviewed covers a variety of subjects such as properties of biomass, overviews of bioconversion technologies, toxic and hazardous properties of alcohols, and sources of biomass. Source listings and selected abstracts are provided back to 1965. Both U.S. government reports and journal publications are listed. Foreign publications are also included. A listing is presented of both U.S. and foreign patents on various subjects related to bioconversion technology and gasohol production. Ethanol and methanol production is considered along with automotive and other fuel uses, the production of chemical feedstocks, and the economics of alcohol production. G.R.

A81-49455 Nonpetroleum vehicular fuels; Proceedings of the Symposium, Arlington, VA, February 11-13, 1980. Symposium

sponsored by the Institute of Gas Technology. Chicago, Institute of Gas Technology, 1980. 377 p. $40.

National energy initiatives are considered along with a systems overview of new automotive fuels, questions of alternative fuels availability, gasohol as a fuel supplement, environmental implications of alternative fuel usage, propane as a high quality engine fuel for commercial applications, compressed natural gas vehicle fuel as a pragmatic alternative, and a gasohol utilization and test program. Engine systems and equipment are discussed, taking into account the engine/fuel couple as a priority research and development target in future research, engine development for alternate fuels for Army ground vehicles, intercity and urban gas turbine powered bus demonstration programs, liquefied petroleum gas carburetion, safety testing of liquefied petroleum gas and gas fueled vehicles, and the potential of electric and hybrid-electric vehicles. Alternative liquid fuels are also examined, giving attention to an alcohol fuels prospective, options for transportation fuels from synthetics, transportation fuels from solvent refined coal refinery, engine-fuel compatibility, methane powered vehicles, liquid methane, liquified natural gas and compressed natural gas fueling systems, and hydrogen as a vehicular fuel. G.R.

A81-49480 **Energy from biomass and wastes IV; Proceedings of the Symposium, Lake Buena Vista, FL, January 21-25, 1980.** Symposium sponsored by the Institute of Gas Technology. Chicago, IL, Institute of Gas Technology, 1980. 843 p. $60.

Attention is given to energy from biomass and wastes, the energy potential of sugar cane and sweet sorghum, the yields of short rotation Eucalyptus Grandis in high density plantings, maximizing forest biomass energy production by municipal wastewater irrigation, and large-scale biomass cogenerated power. Advanced systems concerning residential wood fired furnaces are considered along with environmental impacts of increased fuelwood use, metabolic control for microbial fuel production during thermophilic fermentation of biomass, anaerobic sludge digestion in the presence of lactobacillus additive, the enzymatic enhancement of solid waste bioconversion, and the gasification of organic solid wastes in cocurrent moving bed reactors. Other subjects discussed are related to the Simplex coal and biomass gasification process, molecular mechanisms underlying solar conversion and energy storage by the photocatalytic decomposition of water in photosynthesis, and the production of hydrogen from biomass and wastes. There is also a description of topics which are concerned with the economics of modest size pyrolysis systems providing substitute fuel for existing combustion systems, the gasification of solid waste linked with purification, refuse conversion to methane, the biothermal gasification of biomass, and some practical aspects affecting the operation of a commercial gas producer on biomass. G.R.

A81-49767 # **Experimental use of real time SAR imagery in support of oil exploration in the Beaufort Sea.** J. B. Mercer (Dome Petroleum, Ltd., Calgary, Alberta, Canada), R. T. Lowry, and S. K. Leving (Intera Environmental Consultants, Ltd., Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 143-152. 8 refs. Research supported by Dome Petroleum, Ltd.

SAR imagery, generated in real-time, has been used for the first time to support an Arctic marine operation. During the latter portion of Dome Petroleum's late season drilling program (November 1979) in the Beaufort Sea, the SAR-580 flew daily missions to provide near real-time 'snap shots' of the ice conditions in the vicinity of the operations. The aim of the program was to assist both the icebreaker support of the drillship and the subsequent navigation back to harbor. To provide the context for this SAR application, a review of Beaufort Sea ice conditions is presented along with a brief discussion of the problems and techniques of the interpretation of the SAR imagery. The downlink and operational performance of the SAR are described along with an outline of an improved system. B.J.

A81-49809 # **Detection of changes in a coal surface mining area by ratioing multidate Landsat digital data.** D. O. Ohlen (Technicolor Graphic Services, Inc., Sioux Falls, SD). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 581, 582.

Two procedures are compared for determining change in a coal surface mining area in southern Montana using ratioed multidate Landsat data. Subscenes of Landsat band 5 multispectral scanner data acquired in July 1976 and June 1977 are selected. Each subscene is geometrically corrected to a U.S. Geological Survey 7.5 minute topographic map based and resampled using a 100-meter square pixel. The first procedure used in determining the ranges of ratioed data associated with land cover change involves a comparison of a line printer output of pixel values of the ratioed data with the actual changes that occurred in land cover. The second procedure involves interactive manipulation of the minimum and maximum brightness values in a histogram of the ratioed data to determine which pixels become brighter or darker during the test period. Although the two procedures produce similar results, neither procedure gives results adequate for identifying changes produced by surface mining. C.R.

N81-28201 Tennessee Univ., Knoxville.
HIGH TEMPERATURE COMBUSTION OF PULVERIZED COAL Ph.D. Thesis
William Lee Holt 1981 182 p
Avail: Univ. Microfilms Order No. 8115263

Studies were made on the effects of mixing rate and residence time on the combustion of bituminous coal Nominal heating rates of 100,000 degrees K per second with final combustion temperatures on the other of 3000 K characterized the typical test conditions. The stoichiometry was nominally 0.90 with oxygen concentrations in the oxidant above 55 percent. The experimental results were compared to a theoretical coal combustion model involving a one step, first order Arrhenius reaction rate constant. This model proved to be adequate for the test conditions being studied. Conclusions were reached as to the behavior of pulverized coal under flame conditions such as those that might be experienced in an MHD coal combustor. Qualitative information is presented as to the behavior of the coal particles during combustion and subsequent burn-out of the carbon.
Dissert. Abstr.

N81-28274 California Univ., Berkeley.
LOW TEMPERATURE COAL LIQUEFACTION BY ZINC CHLORIDE AND TETRALIN Ph.D. Thesis
Frank Hershkowitz 1980 158 p
Avail: Univ. Microfilms Order No. 8113063

High conversions of subbituminous coal to liquid or soluble products were obtained by treatment with large amounts of zinc chloride together with tetralin at temperatures below those of coal pyrolysis. Treatments were carried out in a stirred batch reactor at 250 to 325 C for durations of 10 to 120 min with hydrogen at 3.5 MPa total pressure. The extent of conversion was determined by solvent extractions with cyclohexane, toluene, and pyridine, and products were characterized by elemental analysis, gel permeation chromatography, proton nuclear magnetic resonance, and oxygen functional group analysis. The conversions to soluble products reached 50% solubility in cyclohexane and 85% in pyridine for treatment at 300 C. This conversion increased with increasing temperature and duration of treatment, and was accompanied by progressive reductions in molecular weight as well as by elimination of oxygen (especially ether oxygen) in coal. This behavior, along with the increase in product aromaticity with increasing conversion, indicates a mechanism involving $ZnCl_2$-catalyzed cleavage of crosslinking bonds in the coal.
Dissert. Abstr.

N81-28276# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
BEHAVIOR OF FUELS AT LOW TEMPERATURES Interim Report
E. A. Frame Sep. 1980 29 p refs
(Contract DAAK70-80-C-0001)
(AD-A100332; AFLRL-138) Avail: NTIS HC A03/MF A01 CSCL 21/4

In developing the filter/separator component of the Arctic Fuel Dispensing Equipment, MERADCOM is considering two options: (1) development of a completely new filter/separator or (2) modification of the current Military Standard filter/separator for use at low temperatures. This report contains test data on the low-temperature behavior of five test fuels - JP-4, JP-5, JP-8, DF-A, and DF-1 as well as two additional test fuels made by adding icing inhibitor (ethylene glycol monomethyl ether) to the DF-A and DF-1. Four additional fuels were obtained from Alaska (JP-4, Jet A-1, DF-A, and JP-5) and low temperature

behavior of these field samples was determine. This report contains (1) a brief summary of industry practice in handling fuels at low temperatures, (2) inspection properties of test fuels, (3) viscosities and conductivities of fuels at low temperatures, (4) fuel contaminant behavior at low temperatures, and (5) fuel system icing inhibitor effects at low temperatures. Author (GRA)

N81-28283# Gulf Research and Development Co., Pittsburgh, Pa.
METHYL ARYL ETHERS FROM COAL LIQUIDS AS GASOLINE EXTENDERS AND OCTANE IMPROVERS
G. M. Singerman Nov. 1980 35 p refs
(Contract DE-AC01-79CS-50022)
(DOE/CE-50022/1) Avail: NTIS HC A03/MF A01

A mixture of methyl aryl ethers derived from the phenols present in direct liquefaction coal liquids shows considerable promise as a gasoline blending agent and octane improver. The mixture of methyl aryl ethers was blended at five volume percent with a commercial unleaded gasoline. The properties and performance of the blend in a variety of laboratory and automobile tests is reported. The tests show that the mixture of methyl aryl ethers improves gasoline octane without degrading other gasoline properties. DOE

N81-28284# California Univ., Livermore. Lawrence Livermore Lab.
COAL GASIFICATION
Mar. 1981 28 p refs Transl. into ENGLISH from Congr. on the Uses of Coal in the Iron and Steel Ind., Mexico City, Jul. 1978; sponsored by ILAFA
(Contract W-7405-eng-48)
(UCRL-Trans-11686) Avail: NTIS HC A03/MF A01

The theoretical basis for gasification of coals and the various processes for the production of gases from coal, whether having high or low heating value are discussed. The latest methods were developed with a view to the three uses of coal: as a source of energy, as a raw material for the iron and steel is concluded that the process should be of interest as a means of making better use of the coal from southern Brazil. DOE

N81-28289# Pittsburg Univ., Pa. Dept. of Civil Engineering.
BIO-OXIDATION OF THIOCYANATES TYPICAL OF COAL CONVERSION EFFLUENTS Final Report
R. D. Neufeld, Lorraine Mattson, and Patricia Lubon 8 Jan. 1981 142 p refs
(Contract DE-AS02-77EV-04502)
(DOE/ET-04502/7; SETEC-CE-81-001) Avail: NTIS HC A07/MF A01

Data for the biological degradation fate kinetics of thiocyanate removal were developed as well as material balance information for the fate of sulfur and nitrogen resulting from such biodecomposition of aqueous thiocyanates. A literature review of thiocyanate biodegradation was conducted which indicates that while much biochemistry information is available, little information in the biological processing arena is known. Based on both batch and continuous culture experiments utilizing an activated sludge type of system with strictly thiocyanate degrading organisms, the specific utilization rate for SCN degradation was found to follow a substrate inhibition biokinetic relationship. The observed biomass sludge production rate was quantified, as a function of sludge age in the bioreactor. The major metabolic by products of SCN aerobic biodegradation are ammonia and sulfate, with such formation being stochiometric with SCN. DOE

N81-28293# Los Alamos Scientific Lab., N. Mex.
FLASH PYROLYSIS OF COAL THROUGH SOLAR HEATING
W. H. Beattie 1981 22 p refs Presented at the AS/ISES Ann. Conf., Philadelphia, 28-30 May, 1981 Submitted for publication
(Contract W-7405-eng-36)
(LA-UR-81-764; CONF-810509-4) Avail: NTIS HC A02/MF A01

A laboratory technique for studying flash pyrolysis by radiantly heating small stationary samples of powdered coal with the beam of a carbon dioxide laser is described. With this technique flux levels equivalent to those available from solar furnaces are attainable, experimental parameters are easily controllable, and experimental turn around time is short. The pyrolysis of a western subbituminous coal was studied with laser and solar heating. The pyrolysis products were a gas composed principally H2, CH4, CO, and CO2, tar, and char. Under laser heating, the gas yield increased with flux up to W/sq cm. Under conditions of complete pyrolysis, tar and gas yields were inversely proportional to each other and char yield was almost constant. Solar coal pyrolysis experiments at the White Sands Solar Furnace gave results in general agreement with the laser pyrolysis experiments, except that gas yields were higher. DOE

N81-28294# Oak Ridge National Lab., Tenn. Fossil Energy Program.
TECHNICAL AND ECONOMIC EVALUATION OF SELECTED COAL-LIQUEFACTION PROCESSES. PRELIMINARY SCREENING EVALUATION
R. Salmon, R. C. Forrester, III, S. P. N. Singh, J. F. Fisher, R. M. Wham, S. W. Thiel, and J. P. Meyer Apr. 1981 197 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7581) Avail: NTIS HC A09/MF A01

Preliminary scoping evaluations of ten conceptual coal liquefaction processes were made for the Department of Energy using available published information. Production costs calculated under a consistent set of economic criteria varied from $0.78 to $1.47/gal for gasoline in constant 1979 dollars. However, existing design documents showed little consistency as to status of process development, credibility of process design basis, completeness of design, or conservatism of cost estimation. It is concluded that a more complete and thorough design study of each process is necessary to achieve any degree of technical and economic consistency, and that it is therefore not possible to satisfy DOE's desire for consistent technical and economic comparisons in this type of preliminary scoping study. DOE

N81-28295# Sandia Labs., Albuquerque, N. Mex.
ROLE OF SITE CHARACTERISTICS IN THE CONTROL OF UNDERGROUND COAL GASIFICATION
B. E. Bader and R. E. Glass Mar. 1981 27 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-2664) Avail: NTIS HC A03/MF A01

Underground coal gasification (UCG) offers many potential economic and environmental advantages. Offsetting these advantages is the substantial lack of ability to control the UCG process. For example, only three elements of external process control were utilized. These are: (1) injected gas compositions; (2) injected gas flow rate; and (3) product gas pressure. Variation of these independent variables in UCG tests resulted in mixed indications of their effectiveness. Other possible elements of control are indicated based on the results of recent field tests and modeling efforts. These elements are associated with the selection of the specific site where the process is conducted and with the design of the test itself. The results of previous UCG field tests indicated that the conditions that exist in the coal seam and overburden before the start of the combustion process may dominate all other factors. These conditions are the geochemical characteristics, such as faulting and groundwater hydrology, as well as the details of the test layout, well completions, and linking method. DOE

N81-28296# Booz-Allen and Hamilton, Inc., Palo Alto, Calif.
ASSESSMENT OF INTERNATIONAL TAR SANDS RECOVERY AND UPGRADING PROCESSES
Dec. 1980 373 p refs Prepared for California Univ., Livermore. Lawrence Livermore Lab.
(Contract W-7405-eng-48)
(UCRL-15323) Avail: NTIS HC A16/MF A01

Foreign technologies that might aid in the future development of heavy oil deposits in the United States are analyzed. This information on foreign technology developments would aid in formulating and directing policy decisions on future research programs within the United States. Emphasis of the study is on post-1978 developing technologies. The scope includes sizing the resource base and reviewing and evaluating past, present, and planned research and field developments on processes for mining, producing, extracting, and upgrading very heavy oils recovered from tar sands. The characteristics and location of the world's principal tar sands resources are presented. Production methods, both above ground and in-situ, factors inherent in choosing between methods, and the commercial and pilot application of those methods are discussed. The factors are presented which affect the process selection for upgrading bitumen and very heavy oils so they can be piplined and/or refined to a desired mix of consumer products. DOE

N81-28297# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

DESIGN REPORT: SMALL-SCALE FUEL ALCOHOL PLANT
1980 130 p
(Contract DE-AC07-76ID-01570)
(IDO-10088-Vol-1) Avail: NTIS HC A07/MF A01

The objectives of the report are to provide potential alcohol producers with a reference design and provide a complete, demonstrated design of a small scale fuel alcohol plant. This report describes a small scale fuel alcohol plat designed and constructed for the DOE by EG and G Idaho, Inc., an operating contractor at the Idaho National Engineering Laboratory. The plant is reasonably complete, having the capability for feedstock preparation, cooking, saccharification, fermentation, distillation, by product dewatering, and process steam generation. An interesting feature is an instrumentation and control system designed to allow the plant o run 24 hours per day with only four hours of operator attention. Where possible, this document follows the design requirements established in the DOE publication Fuel From Farms, which was publishd by February 1980. DOE

N81-28418*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FOUR BAND DIFFERENTIAL RADIOMETER FOR MONITORING LNG VAPORS Final Report, Dec. 1978 - Jun. 1981
J. J. Simmonds 26 Jun. 1981 35 p refs
(MIPR-Z-70099-8-822868A)
(NASA-CR-164637; JPL-PUB-81-56) Avail: NTIS HC A03/MF A01 CSCL 14B

The development by JPL of a four band differential radiometer (FBDR) which is capable of providing a fast rate of response, accurate measurements of methane, ethane, and propane concentrations on the periphery of a dispersing LNG cloud. The FBDR is a small, low power, lightweight, portable instrument system that uses differential absorption of near infrared radiation by the LNG cloud as a technique for the determination of concentration of the three gases as the LNG cloud passes the instrument position. Instrument design and data analysis approaches are described. The data obtained from the FBDR prototype instrument system deployed in an instrument array during two 40 cubic meter spill tests are discussed. A.R.H.

N81-28452# Department of Energy, Morgantown, W. Va. Valve Testing and Development Projects.
TEST AND EVALUATION OF TWO SIGMON CORPORATION 6-INCH TYPE K BALL VALVES METC SOA TEST VALVE NO. A-4 AND METC SOA TEST VALVE NO. B-4 FOR LOCKHOPPER SERVICE IN COAL CONVERSION
John F. Gardner 28 Feb. 1981 78 p refs
(DOE/METC-SP-129) Avail: NTIS HC A05/MF A01

Two 6-inch Sigmon Corporation type K blocking ball valves were evaluated. Significant difficulties were encountered when performing tests. Problems included excessive leakage rates, galling of valve seats and balls, and a broken valve stem. In the tested configuration, the subject test valves are not recommended for severe service block and seal applications in coal conversion. DOE

N81-28501# Texas Univ. at Arlington. Center for Energy Studies.
OFFSHORE OIL: AN OVERVIEW
Ian R. Manners Jun. 1980 110 p refs
(Policy-Study-11) Avail: NTIS HC A06/MF A01

The decline of traditional offshore oil producing regions and the emergence of newer regions is discussed as well as techniques for deepwater production and offshore exploration. The mobile rig fleet, outer continental shelf frontiers, and exploration licensing are discussed. The hydrocarbon potential of seven nations lying outside the major offshore producing regions of the Middle East, the North Sea, and the United States is assessed. The countries profiled are Australia, Argentina, Brazil, Chile, India, Indonesia, and Mexico. A.R.H.

N81-28506# Adams (Samuel S.) and Associates, Boulder, Colo.
GEOLOGY AND RECOGNITION CRITERIA FOR URANIFEROUS HUMATE DEPOSITS, GRANTS URANIUM REGION, NEW MEXICO Final Report
S. S. Adams and A. E. Saucier (SEDI-MET, Inc., Albuquerque, N. Mex.) Jan. 1981 306 p refs Prepared for Bendix Field Engineering Corp., Grand Junction, Colo.
(Contract DE-AC13-76GJ-01664)
(GJBX-2(81)) Avail: NTIS HC A14/MF A01

The geology of the uraniferous humate uranium deposits of the Grants Uranium Region, northwestern New Mexico, summarized. The geologic characteristics of the uraniferous humate deposits of the Grants Uranium Region are not common in the world, neither are they bizarre or coincidental. The influence of structural control on the location and accumulation of the host sediments is supported considerable data. The host sediments possess numerous important characteristics which influenced the formation of uraniferous humate deposit. Ilmenite magnetite distribution within potential host sandstones is the simplest and most useful regional alteration pattern related to this type of uranium deposit. A method is presented for organizing geologic observation into recognition criteria. It is concluded that the potential of the United States for new districts similar to the Grants Uranium Region is low. DOE

N81-28509# Science Applications, Inc., Morgantown, W. Va.
QUANTITATIVE ANALYSIS OF THE ECONOMICALLY RECOVERABLE RESOURCE
C. V. Pulle and A. P. Seskus May 1981 108 p refs
(Contract DE-AM21-78MC-08216)
(DOE/MC-08216-187) Avail: NTIS HC A06/MF A01

Economically recoverable gas in the Appalachian Basin. Estimates were obtained for a probability distribution, associated with estimates where geologic and production uncertainties prevail. Well productivity on a county and regional basis is lognormally distributed, and the total recoverable gas is normally distributed. With smaller well spacings the estimate is substantially increased, and advanced technology, such as foam fracturing, has the potential of significantly increasing gas recovery. The lognormal distribution of well productivity even in smaller areas, of intense exploration appropriate. The lognormal distribution, represents the small number of wells with relatively very high productivity. DOE

N81-28512 Miami Univ., Fla.
PRINCIPLES OF MANAGEMENT OF MUNICIPAL SOLID WASTE ANAEROBIC BIOCONVERSION FACILITIES Ph.D. Thesis
Jairo Francisco Lascarro 1980 159 p
Avail: Univ. Microfilms Order No. 8114776

A full scale proof of concept plant for the anaerobic conversion of municipal solid waste to methane rich gas was constructed in Pompano Beach, Florida. This facility provided the opportunity to develop baseline management principles and to improve the understanding of this technology. Engineering data and technical concepts were derived from the operation of this plant with a view that it will help in resolving the uncertainties related with this process. Some of the fundamental problems associated with the technical operation of this process are investigated. A summary of economic data is included to emphase those factors which might affect the future development of this technology. Some of the major federal acts associated with this technology are listed to anticipate issues that may hinder the smooth progress of this technology. Dissert. Abstr.

N81-28530# Oak Ridge National Lab., Tenn.
FOSSIL ENERGY PROGRAM Progress Report for November 1980
L. E. McNeese Jan. 1981 118 p
(Contract W-7405-eng-26)
(ORNL/TM-7635) Avail: NTIS HC A06/MF A01

Increased utilization of coal and other fossil fuel alternatives as sources of clean energy is reported. The following topics are discussed: coal conversion development, chemical research and development, materials technology, component development and process evaluation studies, technical support to major liquefaction projects, process analysis and engineering evaluations, fossil energy environmental analysis, flue gas desulfurization, solid waste disposal, coal preparation waste utilization, plant control development, atmospheric fluidized bed coal combustor for cogeneration, TVA FBC demonstration plant program technical support, PFBC systems analysis, fossil fuel applications assessments, performance assurance system support for fossil energy projects, international energy technology assessment, and general equilibrium models of liquid and gaseous fuel supplies. DOE

N81-28532# Sandia Labs., Albuquerque, N. Mex.
GEOTHERMAL DRILLING AND COMPLETION TECHNOLOGY DEVELOPMENT PROGRAM PLAN
Samuel G. Varnado, James R. Kelsey, and Donald L. Wesenberg Feb. 1981 94 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0380) Avail: NTIS HC A05/MF A01

A long-range plan for the development of new technology that will reduce the cost of drilling and completing geothermal wells is presented. The goals of this program are to develop the technology required to reduce the cost of drilling and completing geothermal wells by 25% in the near term and by 50% in the long term. Efforts under this program to date have resulted in new roller bit designs that will reduce well costs by 2% to 4%, new drag bits that have demonstrated marked increases in penetration rate, and the field verification of the effectiveness of inert drilling fluids in reducing drill pipe corrosion. DOE

N81-28535# New Zealand Energy Research and Development Committee, Auckland.
FEASIBILITY OF A GEOTHERMAL DISTRICT HEATING SCHEME
J. J. Lorentz and M. V. Mountfort 1980 47 p refs
(NZERDC-55) Avail: NTIS (US Sales Only) HC A03/MF A01; DOE Depository Libraries

The present development and exploitation of geothermal energy use in Rotorua and Taupo are reviewed with reference to the future development of a Geothermal District Heating (GDH) scheme. Other aspects which affect the future viability of a GDH scheme include: heat load densities for the Rotorua City area and the Taupo Borough area, energy usage patterns in Rotorua and Taupo, and household energy consumption in Rotorua and Taupo. In addition, the results of three market surveys are summarized: of nongeothermal users in residential areas of Rotorua and Taupo, of geothermal users in residential areas of Rotorua, and of non geothermal users in industrial and commercial areas of Rotorua and Taupo. The conclusions drawn from the market surveys were used to formulate recommendations for the futue investigations, and to prepare the terms of reference for a further study project. DOE

N81-28540# Hirai (W. A.) and Associates, Inc., Hilo, Hawaii.
HYDROELECTRIC POWER IN HAWAII. A RECONNAISSANCE SURVEY
Feb. 1981 205 p refs Sponsored in part by Hawaii State Dept. of Planning and Economic Development
(Contract DE-FC49-80R-910031)
(DOE/R9-10031/T2) Avail: NTIS HC A10/MF A01

Hydropower resources in the State of Hawaii are assessed. Hydropower resources on all islands total about 50 megawatts of potential generating capacity. Combined with the 18 megawatts of existing hydropower capacity, hydropower resources potentially could generate about 307 million kilowatt-hours of electric energy annually. This represents about 28 percent of the present combined electricity needs of the Neighbor Islands - Kauai, Molokai, Maui, and the Big Island. The island of Oahu, however, has only small hydropower resources, and could only generate a negligible portion of its electricity needs from this energy source. Existing and potential hydropower capacities are summarized, and annual outputs for each island are estimated. DOE

N81-28578# Institute of Gas Technology, Chicago, Ill. Energy Conversion Systems Group.
APPLICATIONS OF FUSION THERMAL ENERGY TO INDUSTRIAL PROCESSES
Ronald M. Bowman, Bassam J. Jody, and Kuang C. Lu 1980 20 p refs Presented at the 3d Miami Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 15-17 Dec. 1980
(Contract W-31-109-eng-38)
(CONF-801210-24) Avail: NTIS HC A02/MF A01

The feasibility of applying fusion thermal energy as process heat in the iron-steel industry, petrochemical industry, cement industry, and in the production of acetylene from coal via calcium carbide are discussed. These four industries were selected for analysis because they require massive amounts of energy. This preliminary study concludes that the production of synthetic fuels using fusion heat appears to be the most promising method of storing and transporting this heat. Of the four industries studied, the iron-steel and the petrochemical industries appear to be the most promising because they consume substantial amounts of hydrogen and oxygen as feedstocks. These can be produced from water using the high temperature fusion heat. The production of hydrogen and oxygen using fusion heat will also reduce the capital investment required for these industries. These two industries also consume tremendous amounts of heat at temperatures which can be delivered from a fusion blanket via chemical heat pipes. DOE

N81-28582# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
GEOTHERMAL ENERGY FOR HAWAII: A PROSPECTUS
Winifred W. S. Yen and Daniel S. Iacofano Jan. 1981 97 p refs
(Contract W-7405-eng-48)
(LBL-12184) Avail: NTIS HC A05/MF A01

An overview of geothermal development is provided for contributors and participants in the process: developers, the financial community, consultants, government officials, and the people of Hawaii. Geothermal energy is described along with the issues, programs, and initiatives examined to date. Hawaii's future options are explored. Included in appendices are: a technical glossary, legislation and regulations, a geothermal directory, and an annotated bibliography. DOE

N81-28594# Los Alamos Scientific Lab., N. Mex.
GEOTHERMAL RESOURCE BASE OF THE WORLD: A REVISION OF THE ELECTRIC POWER RESEARCH INSTITUTES ESTIMATE
M. J. Aldrich, A. W. Laughlin, and D. T. Gambill Apr. 1981 60 p refs
(Contract W-7405-eng-36)
(LA-8801-MS) Avail: NTIS HC A04/MF A01

Calculating methods for the geothermal resource base of a country show that modifications are needed for the assumptions used in the calculation. The modifications include: (1) separating geothermal belts into volcanic types with a geothermal gradient; (2) using the actual mean annual temperature of a country; and (3) making separate calculations for the resource stored in water/brine and that stored in rock. It is indicated that the method for geothermal resource base calculations yields reasonable values. DOE

N81-28653# Cincinnati Univ., Ohio. Lab. of Sedimentology.
SEDIMENTOLOGY OF GAS-BEARING DEVONIAN SHALES OF THE APPALACHIAN BASIN
Paul Edwin Potter, J. Barry Maynard, and Wayne A. Pryor Jan. 1981 46 p refs
(DOE/METC-114) Avail: NTIS HC A03/MF A01

Sedimentology of the Devonian shales and its relationship to gas, oil, and uranium are reported. Information about the gas bearing Devonian shales of the Appalachian Basin is organized in the following sections: paleogeography and basin analysis; lithology and internal stratigraphy; paleontology; mineralogy, petrology, and chemistry; and gas oil, and uranimum. E.A.K.

N81-28657# Los Alamos Scientific Lab., N. Mex.
REMOTE CHARACTERIZATION OF TIGHT GAS FORMATIONS WITH A NEW NMR LOGGING TOOL
J. A. Jackson, J. A. Brown, and T. R. Crawford 1981 18 p refs Presented at the Joint SPE/DOE Symp. on Low Permeability Gas Reservoirs, Denver, 27-29 May 1981
(Contract W-7405-eng-36)
(LA-UR-81-735; CONF-810518-4) Avail: NTIS HC A02/MF A01

A new nuclear magnetic resonance logging technique was developed. The tool has operating and measurement advantages in tight western gas sand formations over existing nuclear magnetic logging tools. The advantages are: elimination of the need to condition borehole fluids prior to logging a hole; higher sensitivity per unit sample volume; shorter instrumental dead time; and potential for greater formation penetration. The new technique has been laboratory tested in tool geometry. DOE

N81-28682# Battelle Pacific Northwest Labs., Richland, Wash.
WIND ENERGY RESOURCE ATLAS. VOLUME 12: PUERTO RICO AND US VIRGIN ISLANDS
H. L. Wegley, D. L. Elliott, W. R. Barchet, and R. L. George Jan. 1981 93 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3195-WERA-12) Avail: NTIS HC A05/MF A01

The Puerto Rico/US Virgin Island atlas assimilates three collections of wind resource data: one for the region as a whole and one each for both the Commonwealth of Puerto Rico and the US Virgin Islands. For the two subregions, features of the climate, topography and wind resource are discussed in greater detail than is provided in the regional discussion, and the data locations on which the assessment is based are mapped. Variations, over several time scales, in the wind resource at selected stations in both subregions are shown on graphs of monthly average and interannual wind speed and power, and hourly average wind speed for each season. Other graphs present

speed, direction and duration frequencies of the wind at these locations. DOE

N81-28884# Battelle Pacific Northwest Labs., Richland, Wash.
PRACTICAL METHOD FOR ESTIMATING WIND CHARACTERISTICS AT POTENTIAL WIND ENERGY CONVERSION SITES
R. M. Endlich, F. L. Ludwig, C. M. Bhumralkar, and M. A. Estoque Aug. 1980 165 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3808) Avail: NTIS HC A08/MF A01

A method is developed to compute local winds for use in estimating the wind energy available at any potential site for a wind turbine. The method uses the terrain heights for an area surrounding the site and a series of wind and pressure reports from the nearest four or five national Weather Service stations. An initial estimate of the winds in the atmospheric boundary layer is made, then these winds are adjusted to satisfy the continuity equation. In this manner the flow is made to reflect the influences of the terrain and the shape of the boundary layer top. Descriptions of the computer programs, instructions for using them, and complete program listings are included. DOE

N81-28906# Westinghouse Electric Corp., Pittsburgh, Pa. Dept. of Fusion Power Systems.
FEASIBILITY OF RECYCLING THORIUM IN A FUSION-FISSION HYBRID/PWR SYMBIOTIC SYSTEM
J. M. Josephs (Cornell Univ., Ithaca, N.Y.) 31 Dec. 1980 54 p refs
(Contract DE-AC02-77ET-51010)
(DOE/ET-51010/9) Avail: NTIS HC A04/MF A01

A study was made of the economic impact of high levels of radioactivity in the thorium fuel cycle. The sources of this radioactivity and means of calculating the radioactive levels at various stages in the fuel cycle are discussed and estimates of expected levels are given. The feasibility of various methods of recycling thorium is discussed. These methods include direct recycle, recycle after storage for 14 years to allow radioactivity to decrease, shortening irradiation times to limit radioactivity build up, and twhe use of the window in time immediately after reprocessing where radioactivity levels are diminished. An economic comparison is made for the first two methods together with the throwaway option where thorium is not recycled using a mass energy flow model developed for a CTHR (Commercial Tokamak Hybrid Reactor), a fusion fission hybrid reactor which serves as fuel producer for several PWR reactors. DOe

N81-29042# Argonne National Lab., Ill. Energy and Environment Systems Div.
APPLICATION OF A METHODOLOGY FOR EVALUATION OF INTERTECHNOLOGY TRADEOFFS: AN ILLUSTRATIVE CASE STUDY
R. G. Whitfield, W. A. Buehring, M. J. Jusko, and T. D. Wolsko Nov. 1980 49 p refs
(Contract W-31-109-eng-38)
(ANL/EES-TM-127) Avail: NTIS HC A03/MF A01

The problem of selecting the best research and development for developing long term energy technologies that use coal is discussed. Best is defined in terms of 11 attributes, or measures of performance. Uncertainties were determined for the many, complex outcomes that result from each strategy, and the information was systematically structured for evaluation. Preferences for the various outcomes were quantified by assessing a multi-attribute utility function over the 11 single attributes. The best alternative was chosen using maximization of expected utility as a guide. Extensive sensitivity analyses showed that one strategy, evolutionary development, was best over a wide range of plausible assumptions. DOE

N81-29043# Bendix Field Engineering Corp., Grand Junction, Colo.
IMPORTANCE OF RESOLUTION FOR HELIUM DETECTORS USED IN URANIUM EXPLORATION
A. Zalkowski and E. H. Roberts Feb. 1981 19 p refs
(GJBX-38(81)) Avail: NTIS HC A02/MF A01

A small mass spectrometer of the 4He detector type used in uranium exploration was modified to enable magnetic scanning of its mass spectrum. Spectra obtained from the instrument allow determination of interferences from adjacent mass peaks. Hydrogen outgassed from the system or produced by molecular dissociation can be a principal extraneous species. If not thoroughly removed from a system, it can contribute to the ion current of the 4He mass peak. Correlations of 4He with soil gas moisture found in prior studies may not be due to true variation in 4He but may be ascribable to artifacts resulting from H2 contributions to 4He. Such artifacts can be corrected for by converting field instruments to a scanning mode. DOE

N81-29155# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch.
EVAPORATIVE AND EXHAUST EMISSIONS OF TWO AUTOMOBILES FUELED WITH VOLATILITY ADJUSTED GASOHOL
David C. Lawrence and Daniel J. Niemczak Dec. 1980 28 p refs
(PB81-164824; EPA-AA-TEB-81-12) Avail: NTIS HC A03/MF A01 CSCL 21D

The results of a vehicle emission test program conducted by the U.S. EPA in July 1980 are presented. The program was designed to investigate the effects of using various gasohol blends on vehicle evaporative and exhaust emissions. Particular emphasis was directed towards a blended gasohol whose volatility characteristics were adjusted to match as closely as possible those of a baseline gasoline. Two vehicles received triplicate tests on each of four fuels. The analysis also included a gas chromatograph characterization of the SHED vapors for ethanol concentrations and a comparison of carbon balance fuel economy versus volumetric fuel economy. GRA

N81-29219# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
INTERNAL OXIDATION AND SULFIDATION OF IRON-BASED BINARY ALLOYS M.S. Thesis
P. J. Risse May 1981 79 p refs
(Contract W-7405-eng-48)
(LBL-12785) Avail: NTIS HC A05/MF A01

Internal oxidation and sulfidation are addressed as one aspect of the coal gasification corrosion problem. By using different gas mixtures of H2S/H2O/H2/Ar the activities of the oxidants (oxygen and sulfur) are controlled to the point that iron, in the iron based binary alloys (Fe-1% Al, 5% Al, 1% Cr, 5% Cr), appears as a noble metal. The oxidants then diffuse into the noble iron matrix and interact, via precipitation, with the less noble elements, which allows depth of penetration analysis and morphology characterization to be performed. In the latter analysis, continuous subscales were formed both at the relatively high P sub S2 and at a low P sub O2, leaving a narrow range of potentials where the theories of Wagner are applied. The depth of penetration analysis yielded permeabilities (solubility-diffusivity) and effective diffusivity coefficients for the oxidants. DOE

N81-29222# Oak Ridge National Lab., Tenn. Fossil Energy Program.
CORROSION OF HIGH TEMPERATURE MATERIALS IN AFBC ENVIRONMENTS. PART 1: (1500-H TESTS)
R. H. Cooper, T. G. Godfrey, and J. H. DeVan Jun. 1981 39 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7734/P1) Avail: NTIS HC A03/MF A01

Candidate heat exchanger tube materials were tested for times to 1500 h in a small scale atmospheric fluidized bed combustor (AFBC) operated by the FluiDyne Corporation of Minneapolis, Minnesota. The materials included: alloys 800H and 600; types 304, 310, and 316 stainless steel; and aluminized alloy 800 and type 310 stainless steel. These air cooled tubes were exposed to the AFBC environment with wall temperatures ranging from 810 to 875OC, a Ca/S molar ratio of 3.3 to 5.3, 2.5 to 3.5% excess O2, and a fluidizing velocity of 0.7 m/s. Tubes were removed for examination after 500 h of exposure and at the conclusion of the 1500 h test. In general, the materials performed well with moderate fireside scale formation and slight intergranular corrosion. The notable exception was catastrophic corrosion of three alloy 600 tubes shortly after resumption of the test following the 500 h segment. DOE

N81-29247# General Technology Applications, Inc., Arlington, Va.
APPLICATION OF GENERAL TECHNOLOGY APPLICATIONS, INCORPORATED (GTA) BLENDING PROCESS TO ANTIMISTING FUEL ADDITIVES Final Report, Aug. 1980 - May 1981
J. C. Trippe, Paul Waters, and Albert Hadermann May 1981 28 p refs

(Contract DTFA-03-80-C-00070)
(AD-A100692; FAA-CT-81-51) Avail: NTIS HC A03/MF A01 CSCL 21/4

This program examines the applicability of a proprietary blending process to blending antimisting additives in JET A aviation fuel. The first phase of the program covers use of the process with a high molecular weight polyisobutylene. The second phase covers the use of the process with Imperial Chemical Industries, Ltd's proprietary polymer, FM-9. The results of the program indicate that high molecular weight polyisobutyiene can be blended rapidly with JET A using the proprietary process and that the resulting blend demonstrates antimisting behavior within minutes. There was no evidence that the proprietary process is effective in the blending of FM-9 in JET A. Author (GRA)

N81-29248# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
MILITARY FUELS REFINED FROM PARAHO-II SHALE OIL Interim Report, Jun. 1979 - Nov. 1980
J. N. Bowden, E. C. Owens, D. w. Naegeli, and L. L. Stavinoha Mar. 1981 95 p refs
(Contracts DAAK70-78-C-0001; DAAK70-80-C-0001; DA Proj. 1L7-62733-AH-20)
(AD-A101069; AFLRL-131) Avail: NTIS HC A05/MF A01 CSCL 21/4

Shale-derived JP-5, JP-8, aviation turbine fuels and marine diesel fuel were analyzed for compliance with military specifications and evaluated for storage stability, corrosion tendencies, additive response, compatibility with petroleum fuels and microbiological growth susceptibility. The shale fuels behaved very much like petroleum-derived fuels. Turbine combustor evaluation showed a likeness to petroleum-derived Jet A fuel. Performance tests of the shale fuels conducted in four diesel engines also indicated a similarity with the same tests performed with petroleum-derived fuels. Author (GRA)

N81-29258# Institute of Gas Technology, Chicago, Ill.
PREPARATION OF A COAL-CONVERSION-SYSTEMS TECHNICAL DATA BOOK, PART 1 Annual Report, 1 May 1979 - 30 Apr. 1980
Mar. 1981 514 p refs
(Contract DE-AC01-76FT-10255)
(DOE/ET-10255/1-Pt-1) Avail: NTIS HC A22/MF A01

The SURFIMP program of Prausnitz, et al., was used to compute the vapor liquid equilibrium equilibria (VLE) of the NH3-CO2-H2S-H2O system and was compared with the experimental results of IGT, Badger and Silver, and Cardon and Wilson. The results indicate that a better correlation is needed. The salting out coefficients of carbon dioxide by sodium chloride and calcium chloride were correlated with temperature. Thermodynamic properties of furan, tetrahydrofuran, naphthalene, and tetralin are presented in both the English and SI units. Combustion characteristics of low and medium Btu gases and results of experimental evaluations of low Btu gases on utility boiler type burners and industrial burners are stated. The emissions of pollutants from the combustion are discussed. The IGT heating value correlation is evaluated using coal and char data analyzed at IGT for the HYGAS program. The standard deviation of the prediction, using the heating value correlation, is about 85 Btu/lb. DOE

N81-29268# Mueller Associates, Inc., Baltimore, Md.
ETHANOL ENERGY YIELD PER GALLON AND POTENTIAL PETROLEUM DISPLACEMENT
May 1981 25 p refs
(Contract DE-AC05-79CS-56051)
(DOE/CE-56051/3) Avail: NTIS HC A02/MF A01

If the entire respective 1974 and 1975 corn crops had been converted to ethanol for use as gasohol, anywhere from about 224,000 to 333,000 barrels per day (3430 to 5100 million gallons per year) of petroleum (equivalent) could have been displaced if no premium fuels were involved in any way in the processing and transportation of ethanol. The USDA applied a methodology to estimate that current uncultivated lands could produce 17 billion gallons per year of ethanol. Although lacking a link between the quality of these lands and the Farm Production Regions in which they occur, these 17 billion gallons may displace from 97,800 to 444,000 barrels per day (1,500 to 6,800 million gallons per year) of petroleum (equivalent) exclusive of any premium fuels associated with corn processing and ethanol distribution. DOE

N81-29261# Gulf Research and Development Co., Pittsburgh, Pa. Dept. of Chemistry and Minerals.
SOLVENT REFINED COAL (SRC) PROCESS. FLASHING OF SRC-II SLURRY IN THE VACUUM COLUMN OF PROCESS DEVELOPMENT UNIT P-99 Interim Report, Feb. - Jun. 1980
J. A. Gray and S. T. Mathias Oct. 1980 223 p refs
(Contract DE-AC05-76ET-10104)
(DOE/ET-10104/2) Avail: NTIS HC A10/MF A01

This report presents the results of 73 tests on the vacuum flash system of Process Development Unit P-99 performed during processing of three different coals: the second batch, fourth shipment (low ash batch) of Powhatan No. 5 Mine (LR-27383), Powhatan No. 6 Mine (LR-27596), and Ireland Mine (LR-27987). The objective of this work was to obtain experimental data for use in confirming and improving the design of the vacuum distillation column for the 6000 ton/day SRC-II Demonstration Plant. The 900 F distillate content of the bottoms and the percent of feed flashed overhead were correlated with flash zone operating conditions for each coal, and the observed differences in performance were attributed to differences in the feed compositions. Retrogressive reactions appeared to be occurring in the 900 F + pyridine soluble materials leading to an increase in the quantity of pyridine insoluble organic matter. DOE

N81-29262# Department of Energy, Pittsburgh, Pa. Energy Technology Center.
HYDROLIQUEFACTION OF COAL WITH SUPPORTED CATALYSTS: THE 1980 STATUS REVIEW
L. M. Polinski, G. J. Stiegel, and R. E. Tischer Jun. 1981 124 p refs
(DOE/PETC/TR-81/2) Avail: NTIS HC A06/MF A01

The objectives of the program were to determine catalyst deactivation kinetic models and catalyst deactivation modes for supported Co-Mo and Ni-Mo catalysts used primarily in coal liquefaction via the H-COAL process. Emphasis was on developing methods to increase catalyst usage by determining how to decrease catalyst replacement rates in the process and how to increase catalyst poisoning. An important conclusion reached via model analysis and verified by experiment is that larger diameter catalysts resist poisoning deactivation much more than smaller catalysts over extended periods of time. If this trend can be verified, it gives a powerful tool for reducing catalyst replacement rate in the H-COAL ebullated bed system by factors of 2 or more. A second conclusion is that poisoning of catalysts occurs by several possible mechanisms or modes. DOE

N81-29263# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum-Refining Engineering.
MECHANISMS AND KINETICS OF COAL HYDROGENATION Quarterly Progress Report, Jan. - Mar. 1981
R. M. Baldwin and M. W. Furlong May 1981 64 p refs
(Contract DE-AC22-79ET-14881)
(DOE/ET-14881/T1) Avail: NTIS HC A04/MF A01

Colorado School of Mines is engaged in an experimental program to develop comprehensive models for the effects of coal composition upon the kinetics and mechanisms of coal hydrogenation, for the effects of mineral matter additives upon kinetics and mechanisms of coal hydrogenation, and for the kinetics and mechanisms of the of the hydrogenation of coal derived products such as preasphaltenes and asphaltenes. Experimental work was completed on a suite of bituminous coals, this completing the initial phase of the coal reactivity study. Eleven of the 14 coals of the suite were successfully run in duplicate. Conversion of THF solubles was correlated by pseudo-second order kinetics. The resulting kinetic rate constants correlated with H/C ratio, mean-mix vitrinite reflectance, and a specially defined fraction of reactive macerals. Experimental work on the first phase of the disposal catalyst studies was completed. DOE

N81-29286# Pennsylvania Univ., Philadelphia.
ONE-DIMENSIONAL, THREE-PHASE MULTICOMPONENT NUMERICAL SIMULATION OF UNDERGROUND COAL GASIFICATION
S. M. FarouqAli and M. L. Pasha [1981] 40 p refs
(Contract DE-AS21-76MC-08018)
(DOE/MC-08018/T1) Avail: NTIS HC A03/MF A01

The modeling of the process of underground coal gasification in case of a permeable, porous coal bed is presented. In our earlier reports, we have modeled the gasification process by stream method. In all of the previous reports we assumed that

the coal bed consists of 100% carbon. In this simulator, it is assumed that the coal may consist of ash and tar and may produce gases (CO2, CO, H2O, and CH4) as a result of pyrolysis. The numerical simulator was written in FORTRAN IV. The mathematical formulation consists of thirteen equations containing thirteen unknown variables. The equations were divided into three different groups. The equations in each group were solved simultaneously. This program is the result of several other programs written in the early stages of this investigation. All the programs written earlier were rejected because of the development of instability at the last node of the coal bed. This was very dominating in the energy balance equation. To avoid this, two solution approaches for the energy equation were used, one by back substitution, the other by direct solving of the energy equation, once the pressure of the system is determined. DOE

N81-29267# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.
CONVERSION OF WOOD RESIDUES TO DIESEL FUEL
James L. Kuester 1981 19 p refs Presented at the 4th Ann. Wood Energy Program and Contractor Rev. Meeting, Washington, D.C., 9-12 Feb. 1981
(Contract DE-AS02-76CS-40202)
(COO-2982-67; CONF-810237-1) Avail: NTIS HC A02/MF A01

The general scheme for the conversion of wood residues to diesel fuel is presented. The basic approach is indirect liquefaction, i.e., thermal gasification followed by catalytic liquefaction. This approach results in separation of the oxygen in the biomass feedstock, i.e., oxygenated compounds do not appear in the liquid hydrocarbon fuel product. The process is capable of accepting a wide variety of feedstocks. Potential products include medium quality gas, normal propanol, paraffinic fuel, and/or high quality octane gasoline. A flow diagram of the continuous laboratory unit is presented. DOE

N81-29278# Bentz (Edward J.) and Associates, Inc., Springfield, Va.
FACTORS THAT AFFECT THE US MARKET DEMAND AND UTILIZATION OF METHANOL FROM COAL WITHIN THE TRANSPORTATION SECTOR, 1980 - 2000
Edward J. Bentz, Eliahu Salmon, Albert Fry, and Michael Stone Oct. 1980 336 p refs Sponsored by National Alcohol Fuels Commission
(PB81-156457; NAFC-80-13) Avail: NTIS HC A15/MF A01 CSCL 05G

This report is intended solely as an identification and description of selected factors that affect the market for coal methanol in the transportation sector in the period 1980 to 2000. Specific issues and objectives of the report include: (1) potential U.S. market demand, and utilization of methanol from coal within the transportation sector 1980 to 2000; (2) potential impacts of coal methanol fuel technologies; (3) identification and description of key regulatory concerns in the development, usage, and commercialization of coal methanol fuels; and impacts of transportation of coal methanol facilities, and on the utilization and cost of coal methanol fuel. GRA

N81-29279# ICF, Inc., Washington, D. C.
METHANOL FROM COAL: PROSPECTS AND PERFORMANCE AS A FUEL AND AS A FEEDSTOCK
Dec. 1980 204 p
(PB81-169237; NAFC-80-23) Avail: NTIS HC A10/MF A01 CSCL 07A

Methanol from coal was compared with other coal-based synthetic liquids as fuels for automobiles and electric utilities. In addition, methanol from coal is considered as a substitute for the methanol from natural gas now used by the petrochemical industry. The plantgate product cost estimates used throughout the report are presented and explained. Energy uses considered include: Automobile fuels, fuels for electric utilities, and petrochemical feedstocks. GRA

N81-29412# Battelle Pacific Northwest Labs., Richland, Wash.
WIND MEASUREMENT SYSTEMS AND WIND TUNNEL EVALUATION OF SELECTED INSTRUMENTS
J. V. Ramsdell May 1981 79 p ref
(Contract DE-AC06-76RL-01830)
(PNL-3435) Avail: NTIS HC A05/MF A01

Wind tunnel tests of seven relatively inexpensive wind measurement systems were conducted to evaluate the accuracy and reliability of instruments for use in small wind energy conversion system siting studies. Documentation consists of graphs and tables relating system and system component performance to wind speed. Instrument system performance under ideal conditions is described; tests in the atmosphere are required to evaluate performance under realistic conditions. DOE

N81-29452# Galaxy, Inc., Washington, D.C.
STATE-OF-THE-ART OF EUROPEAN R AND D ON COAL-BURNING DIESEL ENGINES: A BRIEF SURVEY
Robert Ware Straus and Gottfried VonBismarck Mar. 1981 56 p
(Contract DE-AC03-79SF-10538)
(DOE/SF-10538/T7) Avail: NTIS HC A04/MF A01

European R and C managers, officials and senior exports with experience in the area of coal-based fuels for diesel engines were interviewed as to the state of the art of coal-burning diesels with specific emphasis on the coal-dust engine, about which highly controversial information had recently been published in Germany. This brief survey allows the following conclusions: activities on coal-burning diesel are reported for Germany, Denmark and Switzerland; in the UK relevant work has recently been stopped. Experts and officials are generally extremely skeptical about the technical data and substance of the widely publicized claims of the BLR. The coal-dust engine appears as fundamentally technically feasible, especially in the area of stationary and low speed applications, but hardly economical. Significant development work is necessary for high speed engines suitable for vehicles. The current development programs indicate coal-oil slurries and other forms of coal suspensions (especially if made from processed, i.e., ash-free coal) may be a promising fuel for diesel engines, in addition to liquid fuels from coal conversion. DOE

N81-29477# National Bureau of Standards, Washington, D.C. Corrosion and Electrodeposition Group.
THE USE OF THE SLOW STRAIN RATE TECHNIQUE FOR THE EVALUATION OF STRUCTURAL MATERIALS FOR APPLICATION IN HIGH TEMPERATURE GASEOUS ENVIRONMENTS Final Report
C. E. Johnson and G. M. Ugiansky Jan. 1981 93 p refs
(Contract EA-77-A-01-6010)
(PB81-179152; NBSIR-81-2191) Avail: NTIS HC A05/MF A01 CSCL 11F

The slow strain rate technique, an accelerated test for determining the performance of structural materials in simulated coal gasification environments was evaluated. Seven alloys, Types 309, 310, 310S, 347 and 446 stainless steels; Incoloy 800; and Inconel 671, were tested at temperatures from 370 to 1040 C at strain rates rom 0.0001 to 10 the minus 7 powers in H2S plus water, gaseous mixtures of CO, CO2, CH2, CH4, H2S, and H2O, and H2O, and in nominally inert environments of He and Ar. It is concluded that the slow strain rate technique is an effective method for evaluating the performance of structural materials in the evaluated temperature gaseous environments. GRA

N81-29514# Dynatech R/D Co., Cambridge, Mass.
ASSESSMENT OF SECONDARY CROP RESIDUES Final Report
E. Ashare, A. P. Leuschner, C. E. West, and B. Langton Mar. 1981 295 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-98175-2) Avail: NTIS HC A13/MF A01

The feasibility of converting secondary agricultural residues to energy in the form of either methane gas or ethyl alcohol is assessed. Secondary agricultural residues are defined as those residues resulting from biomass processing to produce primary products; e.g., whey from cheese processing; vegetable processing wastes; residues from paper pulping; etc. The industries for which data was compiled include vegetable, fruit, seafood, meat, poultry, and dairy processing and the pulp, paper, and paperboard industry. The data collected include raw product input, final processed product output, residue types, and quantity, residue concentration, biodegradability, seasonality of production, and geographic distribution of processing facilities. DOE

N81-29515# Bechtel Corp., San Francisco, Calif.
WESTERN SUBBITUMINOUS COALS AND LIGNITES Final Report

J. D. Ruby and H. Huettenhain Apr. 1981 202 p refs
(EPRI Proj 1030-11)
(EPRI-CS-1768) Avail: NTIS HC A10/MF A01

Reserves, production trends, and characteristics of low rank coals are described. Possible methods for upgrading, including selective mining, cleaning, drying, agglomeration, and ash modification, are discussed. Currently available technology and research and development requirements for upgrading are identified. Information gaps, particularly in the areas of characterization, washability data, and upgrading methods are identified. Upgrading of these coals by physical cleaning is possible and can result in transportation benefits, uniformity of quality, an increase in recoverable reserves through nonselective mining, and probable improvement in ash-fouling characteristics. Improvement in the characteristics of these coals through drying and ash modification by sodium reduction is discussed. DOE

N81-29553# Battelle Pacific Northwest Labs., Richland, Wash.
BENCH-SCALE RESEARCH IN BIOMASS LIQUEFACTION IN SUPPORT OF THE ALBANY, OREGON EXPERIMENTAL FACILITY
Douglas C. Elliott Mar. 1981 30 p Presented at the 12th Thermochem. Conversion Contractors' Meeting, Washington, D.C., 18-19 Mar. 1981
(Contract DE-AC06-76RL-01830)
(PNL-SA-9430; CONF-810360-2) Avail: NTIS HC A03/MF A01

The liquefaction of solid materials (wood, newsprint, animal manure) by beating to produce useful liquid fuels was investigated. Highlights of work performed include: (1) catalyst mechanism studies; (2) analytical reports on TR8 and TR9 product oils; (3) liquid chromatography/mass spectroscopy analysis of wood oil; (4) batch conversion tests on bottom material; (5) vapor pressure studies; and (6) product evaluation. It was confirmed that the key process parameters and the effects of varying operating conditions are in support of biomass liquefaction. DOE

N81-29556# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
SENSITIVITY OF GEOTHERMAL RESERVOIR BEHAVIOR TO RELATIVE PERMEABILITY PARAMETERS
G. S. Bodvarsson, M. J. OSullivan, and C. F. Tsang Dec. 1980 16 p refs Presented at the 6th Workshop on Geothermal Reservoir Eng., Stanford, Calif., 16-18 Dec. 1980
(Contract W-7405-eng-48)
(LBL-12040; CONF-801233-8) Avail: NTIS HC A02/MF A01

Three problems in geothermal reservoir behavior are considered: (1) the sensitivity of the total kinematic viscosity, v sub t, and the flowing enthalpy, h sub f, to variations in the relative permeability functions; (2) the determination of v sub t and h sub f from well test data, following which a method is suggested to use these results together with theoretical plots of the relative permeability functions versus h sub f to deduce the general shape of the relative permeability functions; and (3) the effect of the relative permeability functions on the pressure decline and flowing enthalpy build up during a constant rate production test. It is concluded that the liquid cutoffs are the most important characteristics; relative permeability parameters are determined from field data; and the rise in flowing enthalpy gives information on relative permeability curves. DOE

N81-29558# California Univ., Berkeley. Lawrence Berkeley Lab.
MARINE KELP: ENERGY RESOURCE IN THE COASTAL ZONE
Ronald L. Ritschard and Kendall F. Haven Nov. 1980 25 p refs Presented at the 2nd Symp. on Coastal and Ocean Management, Miami, Fla., 17-20 Nov. 1980
(Contract W-7405-eng-48)
(LBL-12224; CONF-801193-1) Avail: NTIS HC A02/MF A01

The relationship on the marine biomass concept and coastal zone management plans is discussed. An ocean farm system is described. The analysis of the ocean farm system includes a decription of the types of impacts that might occur if large scale operations become available, such as the production of environmental residuals, conflicts with the fishing and shipping industries and other legal/institutional impacts. DOE

N81-29575# Systems Technology Corp., Xenia, Ohio.
EVALUATION OF MIXING SYSTEMS FOR BIOGASIFICATION OF MUNICIPAL SOLID WASTE
Jun. 1981 85 p
(Contract DE-AC05-76CS-20100)
(DOE/CE-20100/1) Avail: NTIS HC A05/MF A01

Two mixing systems were tested for the efficiencies prevention of the formation of fibrous mats and stringers during the anaerobic digestion of a slurried mixture of preprocessed municipal solid waste and sewage sludge in the production of methane gas. The first system was a mechanical agitation, a vessel centered rotary shaft with four blades at each of two levels to drive the slurry downward. The second system included three equidistantly placed gas gun assemblies that each produced bubbles at a constant rate to draw the slurry upward. The microbial culture was healthy in most tests, however, the mixing systems were not effective in preventing excessive fibrous mat and stringer formations. The energy recovered was only 50% of the energy available in the solid waste, and only four times greater than the mixing energy expended for that test. The solids accumulations were generally the same for the two mixing systems when they had common test conditions. In all tests, the percent solids for the top level were higher than those for the middle and bottom levels. DOE

N81-29689# Pacific Northwest Lab., Richland, Wash.
TREATMENT OF BIOMASS-GASIFICATION WASTEWATER
J. V. Maxham Mar. 1981 43 p refs Presented at 12th Biomass Thermochem. Conversion Contractors Meeting, Washington, D.C. 18 Mar. 1981
(Contract DE-AC06-76RL-01830)
(PNL-SA-9388; CONF-810360-3) Avail: NTIS HC A03/MF A01

During conversion, wastewaters are generated that will require treatment prior to reuse in the production process or discharge to the environment. Development of cost-effective wastewater treatment technologies is necessary at the pilot plant stage of production technolgy development. The technical feasibility and cost effectiveness of several promising process technologies for the treatment of biomass gasification wastewater (BGW) were assessed by conducting bench-scale treatability studies. In addition to conventional treatment process options, process technologies were investigated that promise to dramatically reduce treatment time, cost energy consumption, and/or sludge production while preserving the simplicity of operation and mechanical reliability of conventional treatment process options. DOE

N81-29702# Sandia Labs., Albuquerque, N. Mex.
DRILLING, INSTRUMENTATION AND SAMPLING CONSIDERATION FOR GEOSCIENCE STUDIES OF MAGMA-HYDROTHERMAL REGIMES
Richard K. Traeger, Samuel G. Varnado, Anthony F. Veneruso, Vance L. Behr, and Alfonso Ortega May 1981 52 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0800) Avail: NTIS HC A04/MF A01

Drilling, diagnostic, and sampling technologies were reviewed. A strawman drill hole is used for identifying scientific and technological limitations. DOE

N81-29703# IEA Coal Research, London (England).
GEOPHYSICAL EXAMINATION OF COAL DEPOSITS
L. J. Jackson Apr. 1981 116 p refs
(ICTIS/TR-13) Avail: NTIS (US Sales Only) HC A06/MF A01; DOE Depository Libraries

Geophysical techniques for the solution of mining problems and as an aid to mine planning are reviewed. Techniques of geophysical borehole logging are discussed. The responses of the coal seams to logging tools are easily recognized on the logging records. Cores for laboratory analysis are cut from selected sections of the borehole. In addition, information about the density and chemical composition of the coal may be obtained. Surface seismic reflection surveys using two dimensional arrays of seismic sources and detectors detect faults with throws as small as 3 m depths of 800 m. In geologically disturbed areas, good results have been obtained from three dimensional surveys. Smaller faults as far as 500 m in advance of the working face may be detected using in seam seismic surveying conducted from a roadway or working face. Small disturbances are detected by pulse radar and continuous wave electromagnetic methods either

from within boreholes or from underground. Other geophysical techniques which explicit the electrical, magnetic, gravitational, and geothermal properties of rocks are described. DOE

N81-29712# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
REVIEW OF REMOTE-SENSOR POTENTIAL FOR WIND-ENERGY STUDIES
William H. Hooke Mar. 1981 182 p refs
(Contract DE-AI06-79ET-23151)
(DOE/ET-23151/80/1) Avail: NTIS HC A09/MF A01

Systems such as radars, lidars, and acoustic echo sounders are potential alternatives to the cup - and propeller anemometers routinely used in wind energy siting. These systems can be used most effectively in the lattermost stages of the siting process - the site development phase, necessary only for the siting of large wind-energy conversion systems (WFCS) of WECS clusters. For this particular application four techniques appear to be operational. They are, in rough order of increasing expense and operating demands: optical transverse wind sensors; acoustic Doppler sounders; time-of-flight and continuous wave (CW) Doppler lidar; and frequency-modulated, continuous wave (FM-CW) Doppler radar. DOE

N81-29713# Battelle Pacific Northwest Labs., Richland, Wash.
CANDIDATE WIND TURBINE GENERATOR SITE Annual Data Summary, Jan. - Dec. 1980
W. F. Sandusky and D. S. Renne Apr. 1981 126 p
(Contract DE-AC06-76RL-01830)
(PNL-3739) Avail: NTIS HC A07/MF A01

Summarized hourly meteorological data for fourteen candidate and wind turbine generator sites are presented. These data are collected for the Department of Energy for the purpose of evaluating the wind energy potential at these sites and are used to assist in selection of potential sites for installation and testing of large wind turbines in electric utility systems. For each site, data are given in eight tables and one figure. Use of information from these tables, with information about specific wind turbines, should allow the user to estimate the potential for wind energy production at each site. DOE

N81-29929# Battelle Pacific Northwest Labs., Richland, Wash. Dept. of Physical Sciences.
ACCURATE MASS/METASTABLE ION ANALYSIS OF HIGHER-MOLECULAR-WEIGHT NITROGEN COMPOUNDS IN COAL LIQUIDS
B. W. Wilson, Anthony P. Toste, Richard A. Pelroy, Barbara Vieux, and David Wood Mar. 1981 21 p refs Presented at the 20th Ann. Hanford Life Symp., Richland, Wash., 19 Oct. 1980
(Contract DE-AC06-76RL-01830)
(PNL-SA-8852; CONF-801039-7) Avail: NTIS HC A02/MF A01

Mutagenically active subfractions from heavy-end SRC-II coal distillate were analyzed by high resolution mass spectrometry. Molecular ion species having the proper elemental compositions for putative primary aromatic amines thought to be the active constituents in these fractions were then subjected to metastable ion energy analysis. Features of the ion energy spectra thus obtained were compared to those of authentic standards for nitrogen-containing compounds including alkylated and non-alkylated aza arenes, carbazoles and primary aromatic amines. A compound identified amino benzpyrene was found to be a major constituent of the subfraction with the highest mutagenic activity, and absent in those with little or no genetic response. DOE

N81-30103# Federal Aviation Administration, Atlantic City, N.J.
AIRCRAFT RESEARCH AND TECHNOLOGY FOR ANTIMISTING KEROSENE CONFERENCE
Jun. 1981 260 p Proceedings held at Atlantic City, N.J. 18-19 Feb., 1981
(AD-A101347; FAA-CT-81-181) Avail: NTIS HC A12/MF A01 CSCL 01/2

Contents: Antimisting Fuel Engineering and Development Program, Wing Spillage Test, Flammability Comparison Test Apparatus, Large-Scale Aircraft Crash Test of Antimisting Fuel, The Use of Antimisting Kerosene in Turbofan Jet Engines, The Development of ICI'S FM-9 Antimisting Aviation Fuel, Cryogenic Blending Polymer Additives in Fuel, Economic Aspects of Conversion to Antimisting Fuels, UK Programme on Safety Fuels, Fundamental Studies of Antimisting Fuels, Degradation and Characterization of Antimisting Kerosene, Antimisting Fuel Test Correlation Analysis, and KS/DC-10 Fuel System Simulator. GRA

N81-30234# Los Alamos Scientific Lab., N. Mex.
LASER-INDUCED BREAKDOWN SPECTROSCOPY: DETECTING DOSIUM AND POTASSIUM IN COAL-GASIFIERS
T. R. Loree and L. J. Radziemski 1981 30 p refs Presented at the Symp. on Instr. and Control for Fossil Energy Processes, San Francisco, 8 Jun. 1981
(Contract W-7405-eng-36)
(LA-UR-81-1526; CONF-810607-2) Avail: NTIS HC A03/MF A01

A real-time monitor of trace quantities of elements present in hostile environments such as coal gasifier process streams is developed. With laser-induced breakdown spectroscopy, the ability to probe a real process stream and achieve appropriate levels of detectability for sodium and potassium with real-time response is demonstrated. DOE

N81-30254# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
STRESS-CORROSION CRACKING STUDIES IN COAL-LIQUEFACTION SYSTEMS
V. B. Baylor and I. R. Kaiser 1981 34 p refs Presented at the Intern. Corrosion Forum, Toronto, Ontario, 6-10 Apr. 1981; sponsored by the National Association of Corrosion Engineers
(Contract W-7405-eng-26)
(CONF-810402-9) Avail: NTIS HC A03/MF A01

Coal liquefaction plants with 6000 ton/d capacity are currently being planned as a step toward commercial production of synthetic fossil fuels. These plants demonstrate the large scale viability of the solvent refined coal (SRC) process, which was used since 1974 in two operating pilot plants: a 50 ton/d unit at Fort Lewis, Washington, and a 6 ton/d plant in Wilsonville, Alabama. Experience in these plants has shown that austenitic stainless steels are susceptible to stress corrosion cracking associated with residual stresses from cold working or welding. The corrodants responsible for the cracking are not yet positively identified but are suspected to include polythionic acids and chlorides. In order to screen candidate materials of construction for resistance to stress corrosion cracking, racks of stressed U-bend specimens in welded and as-wrought conditions were exposed at the Wilsonville and Fort Lewis SRC pilot plants. DOE

N81-30284# Massachusetts Inst. of Tech., Oak Ridge, Tenn. School of Chemical Engineering Practice.
HYDRODYNAMICS OF COAL-LIQUEFACTION DISSOLVER CONFIGURATIONS
C. F. Irwin, A. J. Sinclali, and E. W. Wong Jun. 1981 72 p refs
(Contract W-7405-eng-26)
(ORNL/MIT-326) Avail: NTIS HC A04/MF A01

The hydrodynamics of two proposed dissolver configurations for the 63.6 kg/s (6000 tpd) SRC-I demonstration plant were examined. Correlations were used to predict the flow patterns, holdups, pressure drops, bubble size distribution, and axial mixing in the dissolvers and piping. Calculations on the performance of dissolver internals revealed slug flow and related pressure fluctuations may present serious control problems. The dissolver internals will be subject to extreme erosion by solids. Hydrogen mass transfer in the bubbly flow regime, expected in the dissolver, is not rate limiting. Liquid axial mixing is significant and will affect the conversion and selectivity. It is recommended that the pressure fluctuations be estimated by dynamic modeling, that the internals be redesigned to reduce the potential for erosion and coking, that the validity of the assumptions be evaluated at system temperature and pressure, and that experimental programs be initiated to correlate flow patterns, gas holdups, and axial dispersion in large diameter pipes and columns with high gas densities and in the presence of solids. DOE

N81-30285# Decision Analysis Corp., Annandale, Va.
ANALYSIS OF ALTERNATIVE-FUEL PRICE TRAJECTORIES
31 Dec. 1980 84 p refs
(Contract DE-AC01-80RG-10446)
(DOE/RG-10446/T1) Avail: NTIS HC A05/MF A01

Findings are presented from a study to acquire, analyze,

and report alternative published price projections including both oil and coal price trajectories. Comparisons of key assumptions underlying the price projections are reported and the applicability of the fixed annuity formula as used in the alternative cost calculation is demonstrated. Graphic presentations of all updated coal and oil price forecasts are included. DOE

N81-30288# Sandia Labs., Albuquerque, N. Mex.
PROCESS FOR EXTRACTING USEFUL, PRIMARILY COMBUSTIBLE GASES, BY IN-SITU GASIFICATION OF UNDERGROUND FOSSIL-FUEL BEDS
P. Ljungstroem Feb. 1981 7 p Transl. into ENGLISH of Swedish Patent no. 130,291 (Appl. no. 8536/1946, 30 Sep. 1946)
(SAND-81-6003) Avail: NTIS HC A02/MF A01

A process is described for overcoming shortcomings, so that the calorie content of the fuel beds can be recovered in a work-saving and economically favorable manner, even if the fuel-bearing beds lie deep under the surface or are not very thick. A smaller portion of the fuel bed is heated electrically and thus brought into a gas-permeable state, whereupon this portion is used to introduce oxygen (air) through the fuel bed, as well as to remove the gases generated by burning the remaining portion of the fuel bed. The process according to the invention is carried out by drilling a group of holes down from the ground surface and inserting electric heating elements in some of them. They feed electrical energy into the fuel bed and induce heating, which creates an advancing front of porous fuel mass. Oxygen (air) is then introduced through one or more of the holes in the group so that the surrounding zones of the fuel bed are made to burn and the combustible gases generated are removed through one of more of the other holes in the group. DOE

N81-30293# Oak Ridge National Lab., Tenn.
OVERVIEW OF COAL CONVERSION
Bruce R. Clark 27 Mar. 1981 25 p Presented at the 70th Two Year College Chemistry Conf., Atlanta, 27 Mar. 1981
(Contract W-7405-eng-26)
(CONF-810362-1) Avail: NTIS HC A02/MF A01

The structure of coal and the processes of coal gasification and coal liquefaction are reviewed. Coal conversion technology is examined as a possible vehicle in providing a significant amount of synthetic fuel within the next few years. Particular emphasis is given to the efforts of both government and private sectors in the development of this technology to hedge against ever diminishing petroleum supplies, especially from foreign sources. The reactions of coal products, and the physics and chemistry involved in the various stages of coal conversion processes are also considered. DOE

N81-30294# Midwest Research Inst., Golden, Colo.
DEMONSTRATION OF DISSOCIATED METHANOL AS AN AUTOMOTIVE FUEL: SYSTEM PERFORMANCE
J. G. Finegold, M. E. Karpuk, J. T. McKinnon, and R. Passamaneck Apr. 1981 5 p refs Presented at Ann. Conf. of the Intern. Solar Energy Soc., Philadelphia, 26 May 1981
(Contract DE-AC02-77CH-00178)
(SERI/TP-731-1178; CONF-810509-26) Avail: NTIS HC A02/MF A01

Testing of a system for providing hydrogen rich gases to an internal combustion engine is described. The endothermic dissociation of methanol on board the vehicle is described. The dissociation of methanol absorbs heat from the engine exhaust and increases the lower heating value of the fuel by 22%. The engine thermal efficiency is increased by raising the compression ratio and burning with excess air. Higher vehicle efficiency than that of cars burning pure alcohol or alcohol blends is obtained. DOE

N81-30296# Oak Ridge National Lab., Tenn. Fossil Energy Program Office.
PYROLYSIS AND PHYSICAL PROPERTIES OF COAL BLOCKS
P. R. Westmoreland, R. C. Forrester, and J. B. Gibson Jun. 1981 186 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7313) Avail: NTIS HC A09/MF A01

Interactions between the various physical properties of coal and its pyrolysis were characterized by studying the heating of 150-mm-diameter cylindrical blocks of Wilcox lignite, Wyodak subbituminous coal, Hanna bituminous coal, and Pittsburgh bituminous coal. In the various coals, block pyrolysis caused gasification and cracking reactions and changes in char reactivity and in swelling, none of which is observed in powder pyrolysis. These changes were interpreted as having resulted from internal temperature gradients and flow patterns. To aid in an evaluation of this interpretation, physical and transport properties of coals were reviewed, measured, and correlated. Data on thermal diffusivity and conductivity of lignite were of particular interest. DOE

N81-30299# Engineering Societies Commission on Energy, Inc., Washington, D. C.
SYNETHETIC FUELS SUMMARY
Mar. 1981 64 p refs
(Contract DE-AC01-77ET-10679)
(DOE/ET-10679/T10; FE-2468-82-A) Avail: NTIS HC A04/MF A01

The Federal government's experience in synfuels, the market potential of synfuels, the US energy resources base, and the numerous technologies available are examined. Technologies and energy resources are reviewed and compared to provide the facts needed to understand existing energy-related problems. An overview of synfuel technologies and markets is given. DOE

N81-30300# Institute of Gas Technology, Chicago, Ill.
UPGRADING HIGH-NITROGEN NATURAL GAS BY SELECTIVE MEMBRANE PERMEATION
C. D. Landahl and D. L. Klass 1981 11 p refs Presented at the 90th AICHE National Meeting, Houston, Tex., 5-9 Apr. 1981 Sponsored in part by InterNorth, Inc., Omaha
(CONF-810417-7) Avail: NTIS HC A02/MF A01

The technical feasibility of membrane separation was examined for high nitrogen natural gas. An extensive screening of commercial and developmental membranes revealed only a few that are selective for nitrogen. Polyacrylonitrile (PAN) exhibited the highest nitrogen methane separation factors of the membranes tested. However, the permeation rates for PAN are too low for a practical separation system. Evaluation of membranes of PAN with vinyl and other polymers indicated that permeation rates could be increased while still maintaining separation efficiency of PAN in bilayer membranes. The experimental methods and results of this work and the potential value of the composite PAN membrane system are discussed. DOE

N81-30302# Argonne National Lab., Ill.
CHEMICAL AND BIOLOGICAL CHARACTERIZATION OF HIGH-BTU COAL GASIFICATION. THE HYGAS PROCESS, 1
V. C. Stamoudis, S. Bourne, D. A. Haugen, M. J. Peak, C. A. Reilly, J. R. Stetter, and K. Wilzbach 1980 39 p refs Presented at the 20th Hanford Life Sci. Symp. Coal Conversion and the Environment: Chem., Biomed., and Ecol. Considerations, Richland, Wash., 19-23 Oct. 1980
(Contract W-7405-eng-38)
(CONF-801039-12) Avail: NTIS HC A03/MF A01

The relationships between mutagenic activity and chemical composition for fractions prepared from process stream materials obtained from a high-Btu coal gasification pilot plant in which the HYGAS process is employed were examined. Fractionation procedures included fractional distillation; extraction of acidic, basic, and neutral components; liquid/liquid partitioning; and column chromatography on silica gel. A large number of organic compounds in the fractions have been identified by fused silica capillary column gas chromatography, and gas chromatography/mass spectrometry (GC/MS). Some fractions contain components that are mutagenic as indicated by the Ames salmonella/microsome mutagenicity assay. Fractionation and GC/MS analysis indicate that the mutagenic components are relatively nonvolatile and that they may include neutral polycyclic aromatic hydrocarbons (PAHs) as well as more polar components such as primary aromatic amines, azaarenes, and hydroxy-PAHs. It is tentatively concluded that the health and environmental risks due to commercialization of the HYGAS would be relatively low. DOE

N81-30303# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
UPGRADING OF COAL-HYDROCARBONIZATION LIQUIDS
Hubert G. Davis, John Potter, and Lou Batta Mar. 1981 20 p refs Presented at the Conf. on Coal Pyrolysis, Palo Alto, Calif., 25-26 Feb. 1981; sponsored by Electric Power Research Inst.
(Contract W-7405-eng-48)

(LBL-12463; CONF-810252-1) Avail: NTIS HC A02/MF A01

In the mid-sixties, Union Carbide seriously considered building a 5000 ton/day plant to hydrocarbonize Wyoming subbituminous coal. The objective was the production of phenol and cresylic acids, with fuel byproducts. The work on upgrading the crude products is discussed briefly in the light of the earlier interest in chemical products and the current interest in synfuels. The original attraction of the process as applied to low rank coal was the substantial yield of phenols. Today it might be the volatile nature of the liquid product. This offers the possibility of converting a high proportion of the crude product to gasoline. DOE

N81-30304# Mound Lab., Miamisburg, Ohio.
INSTRUMENTATION FOR REAL-TIME DATA ANALYSIS AND CONTROL OF SYNTHETIC-FUEL TECHNOLOGIES
R. E. Zielinski, M. K. Agarwal, and P. W. Seabaugh 1981 15 p refs Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, San Francisco, 8 Jun. 1981
(Contract DE-AC04-76DP-00053)
(MLM-2838(OP); CONF-810607-5) Avail: NTIS HC A02/MF A01

Instrumentation and a sample handling system designed for real-time analysis and control of Underground Coal Gasification Field Test in a 900 foot deep, seven foot thick coal seam worked well in capturing all the data to accurately analyze the process and adequately identify necessary process changes. This instrumentation can be modified for application to other coal conversion processes and can also be modified to ensure automatic control for process optimization. DOE

N81-30306# Ames Lab., Iowa.
CORN COB GASIFICATION AND DIESEL ELECTRIC GENERATION
J. J. OToole, T. E. Wessels, B. C. English (Iowa State Univ., Ames), and R. J. Blobaum (Blobaum (Roger) and Associates, Des Moines) 1981 10 p refs Presented at the 8th Energy Technol. Conf., Washingon, D.C., 9-11 Mar. 1981
(Contract W-7405-eng-82)
(IS-M-323; CONF-810315-12a) Avail: NTIS HC A02/MF A01

A program designed to evaluate the collection and transportation costs of corn cobs for the fueling of downdraft gasifiers in the production of low Btu gas is described. The major use of this gas is to fuel diesel/electric generating systems in the many municipalities which can be retrofitted for this purpose. DOE

N81-30307# Argonne National Lab., Ill. Chemical Engineering Div.
STUDY OF INSTRUMENTATION NEEDS FOR PROCESS CONTROL AND SAFETY IN COAL FLUIDIZED-BED COMBUSTION SYSTEMS
C. L. Herzenberg, K. E. Griggs (Fluor Power Services, Chicago), R. F. Henry, and W. F. Podolski Feb. 1981 183 p refs
(Contract W-31-109-eng-38)
(ANL/CEN/FE-80-15) Avail: NTIS HC A09/MF A01

A study was conducted to evaluate the current state of the art of instrumentation for planned and operating fluidized bed combustion systems. This study is intended to identify instrumentation needs and serve as a data base for projects to develop this instrumentation. A considerable number of needs for measurements for which presently available instrumentation is not suitable were reported by respondents. The identified deficiencies are presented with the associated physical parameter ranges for FBC processes. Techniques and instrumentation under development, as well as some available alternative instruments, are discussed briefly. Mechanisms for technical information exchange on instrumentation for fossil energy applications are identified. Development of instruments to meet the identified measurement deficiencies is recommended in order to ensure the feasibility of automatic control of large scale fluidized bed combustion systems and to advance the state of the art of fluidized bed combustion technology. DOE

N81-30310# Argonne National Lab., Ill.
COAL-BASED INDUSTRIAL-FUELS ASSESSMENT
R. S. Bennett, H. J. Takach, W. H. Seward, R. S. Opalanko, and K. E. Wilzbach 1980 16 p refs Presented at the Ann. Meeting of the Air Pollution Control Assoc., Montreal, 22-27 Jun. 1980
(Contract W-31-109-eng-38)
(CONF-800608-6) Avail: NTIS HC A02/MF A01

The results of a study to identify the economic, environmental, and energy impacts of possible new source performance standards (NSPS) are presented for industrial steam generators on potential use of coal and coal derived fuels in such steam generators. In addition, the same impacts for distillate and residual fuel oils were identified for comparative purposes. This assessment will allow for substantive input to assist in responding to the NSPS that will be proposed by EPA. This program utilized a system level approach where the industrial boiler and its fuel supply were considered from the standpoint of a potential industrial user. DOE

N81-30311# Cornell Univ., Ithaca, N. Y. Dept. of Agricultural Economics.
ETHANOL PRODUCTION IN SOUTHWESTERN NEW YORK: TECHNICAL AND ECONOMIC FEASIBILITY Final Report
Robert J. Kalter Jan. 1981 313 p refs Sponsored by New York State Energy Research and Development Authority
(PB81-188914; NYSERDA-81-3) Avail: NTIS HC A14/MF A01 CSCL 21D

The development of one or more centralized ethanol conversion facilities in the southwestern portion of New York State is discussed. Likely to be commercially feasible if either locally produced cheese whey and/or imported corn are used as a feedstock, development is shown to be highly profitable under a broad range of economic conditions and technical considerations. Four plant designs ranging in annual production capacity from 1.675 to 27.5 million gallons of ethanol (utilizing alternative feedstocks) are investigated. Maximum profitability per unit production are obtained from a 2.5 million gallon plant using only whey. GRA

N81-30404# Air Products and Chemicals, Inc., Allentown, Pa
GAS/SLURRY FLOW IN COAL-LIQUEFACTION PROCESSES (FLUID DYNAMICS IN 3 PHASE FLOW COLUMNS) Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1980
David H. S. Ying, R. Sivasubramanian, and Edwin N. Givens Dec. 1980 52 p refs
(Contract DE-AC01-79ET-14801)
(DOE/FT-14801/12) Avail: NTIS HC A04/MF A01

The 6000 T/D SRC-I demonstration plant will employ vertical tubular reactors feeding slurry and gas concurrently upward. This reactor is essentially an empty vessel with only a distributor plate located near the inlet. Because the commercial plant represents a considerable scale-up over either Wilsonville or Ft. Lewis, this program is addressing the need for additional data on the behavior of three phase systems in large vessels. Parameters are being studied at conditions that relate directly to the projected demonstration plant operating conditions. Air/water/sand three phase flow system in both a 5-inch diameter and a 12-inch diameter column is used in this cold-flow simulation study program. DOE

N81-30450# General Electric Co., St. Petersburg, Fla.
PERFORMANCE OF AIR-COOLED POWER PLANTS USING GAS FROM COAL Final Report
S. D. Shemo May 1981 154 p refs Sponsored by EPRI
(EPRI Proj. 986-3)
(EPRI-AP-1844) Avail: NTIS HC A08/MF A01

The thermal performance and water use of various power plants using coal gasification systems integrated with combustion turbines and under minimum water use conditions are determined. The gasifiers considered are the oxygen blown gasifier, the oxygen blown slagging gasifier, and air blown gasifiers. These gasifiers are each integrated with simple combustion turbine cycles, regenerative combustion turbine cycles and combined cycles. The performance of these dry cooled integrated plants is compard to that of wet cooled integrated gasification combined cycle systems and conventional coal fired plants. DOE

N81-30497*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SAFETY EVALUATION METHODOLOGY FOR ADVANCED COAL EXTRACTION SYSTEMS
Wayne F. Zimmerman 15 Jul. 1981 107 p refs
(Contracts NAS7-100; DE-AI01-76ET-12548)
(NASA-CR-164703; JPL-Pub-81-54) Avail: NTIS HC A06/MF A01 CSCL 08I

Qualitative and quantitative evaluation methods for coal extraction systems were developed. The analysis examines the soundness of the design, whether or not the major hazards have been eliminated or reduced, and how the reduction would be accomplished. The quantitative methodology establishes the approximate impact of hazards on injury levels. The results are weighted by peculiar geological elements, specialized safety training, peculiar mine environmental aspects, and reductions in labor force. The outcome is compared with injury level requirements based on similar, safer industries to get a measure of the new system's success in reducing injuries. This approach provides a more detailed and comprehensive analysis of hazards and their effects than existing safety analyses. E.A.K.

N81-30600# Georgia Univ., Athens. Dept. of Microbiology.
MICROBIOLOGICAL ASPECTS OF OIL PRODUCTION
W. R. Finnerty 1981 18 p refs
(Contract DE-AS09-80ER-10683)
(DOE/ER-10682/2) Avail: NTIS HC A02/MF A01

Reservoir microbiology is discussed. One oil release technique is an anaerobic fermentation within a reservoir. Biopolymers and polysaccharides have application in EOR. Hydrocolloids and surfactants of microbial origin are listed and their possible application mentioned. An example of the appapplication of bioengineering principles is bacterial desulfurization. DOE

N81-30601# D'Appolonia (E.) Consulting Engineers, Inc., Pittsburgh, Pa.
EVALUATION OF HOT DRY ROCK EXPLORATION TECHNIQUES IN THE ATLANTIC COASTAL PLAIN: A TEST SITE ON THE DELMARVA PENINSULA OF MARYLAND AND VIRGINIA
Apr. 1981 26 p refs
(Contract W-7405-eng-36)
(LA-8800-MS) Avail: NTIS HC A03/MF A01

The findings favor the HDR exploration program that is outlined for locating a deep test hole in an area with presumed HDR potential (higher than normal heat flow). Six potential sites for extracting HDR energy were identified within the Cris-Wall area. Each site is thought to have temperatures at the basement rock surface in excess of 75 C and to be at least 1 km away from the nearest fault. DOE

N81-30602# Rice Univ., Houston, Tex. Dept. of Geology.
METHODS DEVELOPMENT AND APPLICATIONS EVALUATIONS OF NURE AERIAL RECONNAISSANCE SURVEY DATA FOR URANIUM RESOURCE EVALUATION: BEEVILLE/BAY CITY AND CRYSTAL CITY QUADRANGLES, TEXAS Final Report
John A. S. Adams, Sam F. Harrill, and J. E. Oddo Apr. 1981 115 p refs Prepared for Bendix Field Engineering Corp., Grand Junction, Colo.
(Contracts DE-AC08-76NV-01183; DE-AC13-76GJ-01664)
(GJBX-69(81)) Avail: NTIS HC A06/MF A01

The NURE open-file reports on the aerial gamma spectrometric, hydrologic, and stream-sediment surveys of some 50,000 square kilometers of land area in south Texas were studied in regard to their utility in identifying regions of high or higher favorability for uranium deposits. Substantial agreement was found between the NURE aerial data and the ground and helicopter data as regards the general radioelement distributions in the stratigraphic units studied. The vehicle-mounted gamma-ray spectrometer used systematically gave some 30 percent higher thorium concentration estimates when compared with those from the NURE aerial data. The NURE aerial data are adequate in number to characterize the major stratigraphic units, but they may not be quantitative enough for detailed comparisons from one quadrangle to another, and the optimum sampling area for each formation is not known. DOE

N81-30603# New Mexico Inst. of Mining and Technology, Socorro.
DISPLACEMENT OF OIL BY CARBON DIOXIDE Final Report
F. M. Orr, Jr. and J. J. Taber May 1981 167 p refs
(Contract DE-AS21-78ET-12082)
(DOE/ET-12082/9) Avail: NTIS HC A08/MF A01

Factors influencing CO2 flooding are reported. Procedures are given for an experiment in which equilibrium phase compositions can be measured rapidly and continuously. Results of displacements of crude oil from slim tubes, cores and mixing cells are presented and interpreted in terms of detailed measurements of the phase behavior and fluid properties of the CO2 crude oil mixtures. Direct evidence is presented of the efficiency with which a CO2 rich liquid phase can extract hydrocarbons from a crude oil. A simple one dimensional process simulator for CO2 flooding applications is described. Simulation results are compared with experimental data from slim tube displacements. Comparison of displacement results, phase behavior measurements, and model calculations provides strong evidence that the high displacement efficiency which can be obtained when pressure is high enough and viscous fingering is controlled is the result of efficient extraction of a broad range of hydrocarbons by a dense CO2 rich phase which is a liquid if the temperature is below about 50 C (130 F). DOE

N81-30604# Gulf Universities Research Consortium, Bellaire, Tex.
SURVEY OF ACTIVITY IN THE AREA OF INSTRUMENTATION FOR RESERVOIR DESCRIPTION FOR ENHANCED OIL RECOVERY Final Report
May 1981 77 p refs
(Contracts DE-AC01-78ET-10145; EX-76-C-01-2025)
(DOE/ET-10145/64; GURC-173) Avail: NTIS HC A05/MF A01

The state-of-the-art and progress in the types of instrumentation applied to reservoir description are reviewed. Sources of reservoir information are cores, wire line logs and well tests. The new techniques involve geophysics, geochemistry and tracer testing for oil recovery, the instrumentation must be capable to measure smaller scale effects with great accuracy. Computer simulation utilizing geological detail project the behavior of the EOR processes selected for the reservoir. DOE

N81-30605# Los Alamos Scientific Lab., N. Mex.
SEASAT SATELLITE INVESTIGATION OF THE STRUCTURE OF WESTERN NEBRASKA AND ITS APPLICATION TO THE EVALUATION OF GEOTHERMAL RESOURCES
J. Stix 1981 20 p refs Presented at the Intern. Symp. of Remote Sensing of Environ., Ann Arbor, Mich., 11-15 May 1981
(Contract W-7405-eng-36)
(LA-UR-81-1454; CONF-810557-1) Avail: NTIS HC A02/MF A01

Seasat synthetic aperture radar (SAR) satellite imagery was used to interpret the structural framework and the geothermal potential of an area in western Nebraska. Lineaments were mapped from the imagery and then compared to known structure. It was found that Seasat does record surface manifestations of subtle basement structures, particularly faulting. Four areas with geothermal potential were delineated using Seasat and other data. It is concluded that Seasat imagery is a useful reconnaissance exploration tool in the interpretation of regional structure within areas of little topographic relief. DOE

N81-30554*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Chemical and Biological Processes Section.
ADVANCED DEVELOPMENT: FUELS
Kumar Ramohalli *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev. Proc. 1 May 1981 p 257-261 ref Sponsored by DOE
Avail: NTIS HC A13/MF A01 CSCL 10A

The solar thermal fuels and chemicals program at Jet Propulsion Laboratory are described. High technology is developed and applied to displace fossil fuel (oil) use in the production/processing of valuable fuels and chemicals. The technical and economic feasibility is demonstrated to extent that enables the industry to participate and commercialize the product. A representative process, namely Furfural production with a bottoming of acetone, butanol and ethanol, is described. Experimental data from all solar production of furfural is discussed. Estimates are given to show the attractiveness of this process, considering its flexibility to be adaptable to dishes, troughs or central receivers. Peat, lignite and low rank coal processing, heavy oil stripping and innovative technologies for process diagnostics and control are mentioned as examples of current projects under intensive development. S.F.

N81-30606# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
PERFORMANCE MATCHING AND PREDICTION FOR SERRAZZANO GEOTHERMAL RESERVOIR BY MEANS OF

NUMERICAL SIMULATION

K. Pruess, O. Weres, R. Schroeder, R. Marconcini (ENEL, Firenze), and G. Neri (ENEL, Firenze) Oct. 1980 51 p refs Presented at the 2nd. DOE-ENEL Workshop for Cooperative Res. in Geothermal Energy, Berkeley, Calif., 20-24 Oct. 1980
(Contract W-7405-eng-48)
(LBL-12174; CONF-801098-2) Avail: NTIS HC A04/MF A01

The simulator SHAFT79 was applied to field wide distributed parameter simulation of the vapor dominated geothermal reservoir at Serrazzano, Italy. Using a three dimensional geologically accurate mesh and detailed flow rate data from 19 producing wells, a period of 15.5 years was simulated. The reservoir model used is based on field measurements of temperatures and pressures, laboratory data for core samples, and available geological and hydrological information. The main parameters determined during development of the simulation are permeabilities and much of the initial conditions. DOE

N81-30621# National Center for Resource Recovery, Washington, D. C.

WASTE-TO-ENERGY COMPENDIUM Final Report

Apr. 1981 125 p refs Prepared in cooperation with Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho
(Contract DE-AC01-76CS-20167)
(DOE/CE-20167/05) Avail: NTIS HC A06/MF A01

A survey is made of 35 waste energy recovery projects throughout the U.S. Included are nine refuse derived fuel (RDF) production facilities, six RDF user facilities, two combined RDF production user facilities, and 18 mass burning facilities with energy recovery. Only those facilities that are fully operational or those in advanced stages of startup and shakedown are surveyed. Information is provided on processing capacities, operation and maintenance problems, equipment specifications, capital and operating costs, and the current status of each facility. In addition, process flow schematic are provided for each of the nine RDF production plants and both RDF production user plants. DOE

N81-30627# Public Technology, Inc., Washington, D. C.

STATUS REPORT ON ENERGY RECOVERY FROM MUNICIPAL SOLID WASTE: TECHNOLOGIES, LESSONS AND ISSUES. INFORMATION BULLETIN OF THE ENERGY TASK FORCE OF THE URBAN CONSORTIUM

1980 62 p refs
(Contract DE-FG02-78IR-05106)
(DOE/IR-05106/T6) Avail: NTIS HC A04/MF A01

Focus is on technologies and issues significant to currently operating energy recovery systems in the US - waterwall incineration, modular incineration, refuse derived fuels systems, landfill gas recovery systems. Some basic conclusions are presented concerning the state of the art of energy from waste. Plants in shakedown or under construction, along with technologies in the development stages, are briefly described. Sources of additional information and a bibliography are included. DOE

N81-30644# California Univ., Livermore. Lawrence Livermore Lab.

GEOTHERMAL INJECTION MONITORING PROJECT

L. Younker, P. Kasameyer, A. Smith, E. Didwall, J. Hanson, D. Helm, W. Murray, and J. Hearst Apr. 1981 52 p refs
(Contract W-7405-eng-48)
(UCID-19066) Avail: NTIS HC A04/MF A01

Background information is provided on the geothermal brine injection problem and each of the project tasks is outlined in detail. These tasks are evaluation of methods of monitoring the movement of injected fluid, preparation for an eventual field experiment, and a review of groundwater regulations and injection programs. DOE

N81-30650# Polytechnic Inst. of New York, Brooklyn.

HYDROPOWER UTILIZATION IN NEW YORK STATE Final Report

Rubin S. Brown and Alvin S. Goodman Sep. 1980 93 p
(PB81-194219; NYSERDA-80-10) Avail: NTIS HC A05/MF A01 CSCL 10B

A master inventory of hydropower sites in New York is reported. It includes: data on site identification, potential capacity, initial cost, cost per kWh and category class for development. Background information on the methodologies used to structure the inventory of hydropower sites and to rank selected site entries by development categories. An explanation of the economic assessment utilized in these projects is included. GRA

N81-30652# Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.

HYDROPOWER POTENTIAL OF THE NEW YORK STATE BARGE CANAL

Alvin S. Goodman and Rubin S. Brown New York New York State Energy Research and Development Authority Sep. 1980 124 p refs Sponsored by New York State Energy Research and Development Authority
(PB81-182347; NYSERDA-80-25) Avail: NTIS HC A06/MF A01 CSCL 10B

The physical characteristics of the canal system as it relates to hydropower development were studied. The hydropower potential of the canal system was determined, including an inventory of existing and proposed hydropower plants. The remaining unrealized potential of the canal system was evaluated. Various sites were selected for further investigation on the basis of the unrealized potential of the barge canal system. Preliminary estimates of the engineering and economic feasibility of developing hydropower at these sites were also studied. GRA

N81-30662# Chevron Resources Co., San Francisco, Calif.

BEOWAWE GEOTHERMAL AREA EVALUATION PROGRAM Final Report, 1 Nov. 1978 - 31 Jul. 1980

J. L. Iovenitti Mar. 1981 218 p
(Contract DE-AC08-78ET-27101)
(DOE/ET-27101/1) Avail: NTIS HC A10/MF A01

Several exploration programs were conducted at the Beowawe Geothermal Prospect, Lander and Eureka County, Nevada. A shallow temperature hole program, a mercury soil sampling survey, and a self potential survey were conducted to select the optimum site for an exploratory well. A 5927 foot exploratory well was drilled running geophysical logs. A drill stem test was conducted along with a short term flow test. Basic data collected are summarized. DOE

N81-30725# Holmes and Narver, Inc., Las Vegas, Nev. Energy Support Div.

GEOTHERMAL INDUCED SEISMICITY PROGRAM PLAN

Mar. 1981 21 p
(Contract DE-AC08-78NV-00020)
(HN-00020-1094) Avail: NTIS HC A02/MF A01

The program calls for baseline seismic monitoring in regions of known future geothermal development, continued seismic monitoring and characterization of earthquakes in zones of geothermal fluid production and injection, modeling of the earthquake-inducing mechanism, and in situ measurement of stresses in the geothermal development. The Geothermal Induced Seismicity Program (GISP) will have as its objectives the evaluation of the seismic hazard, if any, associated with geothermal resource exploitation and the devising of a technology which, when properly utilized, will control or mitigate such hazards. DOE

N81-30727# Sandia Labs., Albuquerque, N. Mex.

APPLICATIONS OF REFLECTION SEISMICS TO MAPPING COAL-SEAM STRUCTURE AND DISCONTINUITIES

T. L. Dobecki and L. C. Bartel 1981 7 p refs Presented at the Conf. on the Ground Control in Mining, Morgantown, W. Va., 27 Jul. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1069C; CONF-810714-1) Avail: NTIS HC A02/MF A01

Three US field projects were reviewed. Each project employed its own particular seismic technique, recording system, and seismic energy source although all are considered state-of-the-art, high resolution, digital seismic surveys. Project 1 (thin, Pennsylvania coal) sought detection of sand channels using dynamite and standard in-line (2-D) seismic technique. Project 2 (thick, Wyoming underground coal gasification) involved a gas-explosion (Dinoseis) source with areal (3-D) acquisition methods. Project 3 (thick Washington underground coal gasification) employed a shotgun-type source and standard in-line methods. Each project was successful in accomplishing its own particular objective; however, data quality and interpretation seem to be more a function of thickness of the target seam, complexity of the overburden, and processing contractor than a seismic source, acquisition scheme (2-D versus 3-D), or recording instrumentation. DOE

N81-30729# Los Alamos Scientific Lab., N. Mex.
LOCATION, AGE, AND ROCK TYPE OF VOLCANIC ROCKS YOUNGER THAN 5 MILLION YEARS IN ARIZONA AND NEW MEXICO
M. J. Aldrich, Jr. and A. W. Laughlin Apr. 1981 24 p refs
(Contract W-7405-eng-36)
(LA-8820-MS) Avail: NTIS HC A02/MF A01

As part of the assessment of the Hot Dry Rock geothermal energy potential of Arizona and New Mexico, a compilation of the locations and ages of volcanic rocks less than 5 million years was made. The locations of those rocks less than 3 million years are shown on a map of the region. The compilation is presented as a tabulation. The table is organized first by state and secondly by latitude and longitude within each state. Rock type, age and error, method of dating, and original reference are given. DOE

N81-30731# Texas Univ., Austin. Bureau of Economic Geology.
STRUCTURE OF THE PRESIDIO BOLSON AREA, TEXAS, INTERPRETED FROM GRAVITY DATA
J. R. Mraz and G. R. Keller 1980 23 p refs Prepared in cooperation with Texas Univ. at El Paso
(Contracts DE-AS05-76ET-28388; EY-76-S-05-5106)
(DOE/ET-28388/T1) Avail: NTIS HC A02/MF A01

The structure and tectonism of a region was studied. The integrated geophysical geology of the Presidio area, Texas, using gravity measurements and deep drilling data was examined. New gravity data were combined with existing data to construct simple Bouguer anomaly maps of the Presidio area, and two dimensional computer modeling of gravity profiles was used to derive earth models. These data outline the major geologic features of the area that are dominated by the effects of Tertiary block faulting and volcanism. The main feature was the Presidio Graben, which is approximately 1.5 km deep near Ruidosa, Texas. It was found that hot springs associated with the Presidio Graben derive their heat from deep circulation along its boundary faults. However, some gravity anomalies indicate the presence of late Tertiary intrusions which provide heat for the hot springs. DOE

N81-30749# GEOMET, Inc., Gaithersburg, Md.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE NORTHEAST REGION
K. E. Pickering, J. M. Vilardo, and J. T. Schakenbach Jun. 1980 191 p refs Prepared for Battelle Pacific Northwest Labs.
(Contract DE-AC06-76RL-01830)
(PNL-3452) Avail: NTIS HC A09/MF A01

Techniques developed to assess the wind energy resource in the Northeast are described. Wind data locations were identified and the data obtained were screened to determine their usefulness. Summarized data were processed and wind power values were estimated for all data locations. Upper air data were used to estimate wind power on mountaintops and ridge crests. Additional information on the wind resource was gained through a survey of wind-deformed vegetation. Maps of annual and seasonal wind power classes were constructed from the computed wind power values along with the aid of landform and shaded relief maps. DOE

N81-30750# Western Scientific Services, Inc., Fort Collins, Colo.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE NORTH CENTRAL REGION
D. L. Freeman Mar. 1981 84 p refs Prepared for Battelle Pacific Northwest Labs.
(Contract DE-AC06-76RL-01830)
(PNL-3667) Avail: NTIS HC A05/MF A01

The development of a regional wind energy resource atlas for the North Central Region, which consists of North Dakota, South Dakota, Nebraska, Minnesota, and Iowa is discussed. A description of observational and analytical techniques used in the development of the North Central region's wind energy resource atlas is given. DOE

N81-30751# Environmental Research and Technology, Inc., Concord, Mass.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE GREAT LAKE REGION
D. L. Paton, A. Bass, and D. G. Smith Feb. 1981 132 p refs Sponsored by DOE Prepared for Battelle Pacific Northwest Lab., Richland, Wash.
(Contract DE-AC06-76RL-01830)
(PNL-3668) Avail: NTIS HC A07/MF A01

A supplement to the wind energy resources atlas for the Great Lakes region is presented. It incudes a detailed discussion of the methodologies and data employed to complete the atlas. A summary of the regional annual average wind power is given, highlighting the major wind resource areas. DOE

N81-30752# GEOMET, Inc., Gaithersburg, Md.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE SOUTHEAST REGION
J. Zabransky Jan. 1908 138 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3669) Avail: NTIS HC A07/MF A01

Techniques developed to assess the wind energy resource in the Southeast are described. Wind data locations were identified and the data obtained were screened. Summarized data were processed and wind power values were estimated for all data locations. Upper air data were used to estimate wind power on mountaintops and ridge crests. Maps of annual and seasonal wind power classes were constructed from the computed wind power values along with the aid of landform and shaded relief maps. It is concluded that various topographic and landform features can be associated with high or low wind power. DOE

N81-30753# Western Scientific Services, Inc., Fort Collins, Colo.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE SOUTHERN ROCKY MOUNTAIN REGION
D. L. Freeman and S. R. Anderson Apr. 1981 97 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3671) Avail: NTIS HC A05/MF A01

The development of a regional wind energy resource atlas for the Southern Rocky Mountain region, which consists of Arizona, Colorado, New Mexico, and Utah is discussed. Observational and analytical techniques used in the development of the Southern Rocky Mountain region's wind energy resource atlas are described. DOE

N81-30754# Global Weather Consultants, Inc., San Jose, Calif.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN THE SOUTHWEST REGION
R. L. Simon and G. T. Norman Dec. 1980 43 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3672) Avail: NTIS HC A03/MF A01

The methodology used to generate the resource assessment and the results obtained are discussed in a manner useful and instructive to other professionals in the wind resource assessment field. DOE

N81-30755# Hawaii Univ., Honolulu. Dept. of Meteorology.
TECHNIQUES FOR ASSESSING THE WIND ENERGY RESOURCE IN HAWAII AND PACIFIC ISLANDS REGION Final Report
T. A. Schroeder Aug. 1980 42 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3673; UHMT-80-04A) Avail: NTIS HC A03/MF A01

The procedures utilized in preparing the Wind Energy Resource Atlas for Hawaii and Pacific Islands Region are contrasted with those used in other regional assessments. Techniques generally paralleled those of the northwest wind resource assessment. Quality of data bases differed drastically between Hawaii and the Pacific Islands. Research data sets constituted a primary data source for Hawaii, but such sets were nonexistent for the Pacific Islands. Forest Service data had minor impact in Hawaii, none in the Pacific Islands. Many Pacific Island anemometers are poorly exposed since limited open spaces exist on small atolls. DOE

N81-30756# Nevada Univ., Reno. Atmospheric Sciences Center.
ICING ON WIND-ENERGY SYSTEMS
Thomas Hoffer, Tony Reale, and Ashraf Elfigi Jan. 1981 74 p refs
(Contract DE-AC06-79ET-23170)
(DOE/ET-23170/80/1) Avail: NTIS HC A04/MF A01

Procedures for analyzing data to determine the maximum possible icing to be expected at specified locations are reported. The procedures for predicting maximum glaze ice and rime are presented in separate sections. Models that simulate the maximum

possible ice building on an exposed surface using the rainfall and cloud water data as input are presented. The maximal dynamic and static icing loads, comparative icing values based on actual field conditions simulations are shown. Assumptions of droplet splashing and water drainage for the glaze cases and atmospheric mixing during orographic lifting for rime cases are included. DOE

N81-30757# New Mexico State Univ., University Park. Physical Science Lab.
ASSESSING THE LOCAL WIND FIELD AT SIERRA GRANDE MOUNTAIN IN NEW MEXICO WITH INSTRUMENTATION
K. M. Barnett and R. D. Reynolds 1958 116 p refs Sponsored by DOE Prepared for Battelle Pacific Northwest Labs., Richland, Wash.
(PNL-3623) Avail: NTIS HC A06/MF A01

Operation of an instrumented wind speed and direction measurement data acquisition program at several locations on the mountain is described. Operating problems are discussed, a cost estimate presented, and data obtained during the six month program analyzed. Estimated energy output of a large wind energy conversion system (WECS) located on the eastern side of the peak is presented. Changes in methodology for similar measurement operations at potential WECS sites are recommended. DOE

N81-31324# California Univ., Livermore. Lawrence Livermore Lab.
FLAME PROPAGATION IN GASEOUS FUEL MIXTURES IN SEMICONFINED GEOMETRIES
P. A. Urtiew 7 Apr. 1981 37 p refs
(Contract W-7405-eng-48 oi MF)
(UCID-19000) Avail: NTIS HC A03/MF A01

Work on flame propagation in gaseous fuels contained in semiconfined geometries is reported. Parameters that have an effect on flame propagation, flame acceleration, and the transition from deflagration to detonation are described. Turbulence-producing obstacles in the flow path are the primary cause of acceleration of the flame front. DOE

N81-31379 Rice Univ., Houston, Tex.
CONVERSION OF METHANOL AND LIGHT OLEFINS TO GASOLINE OVER A SHAPE SELECTIVE CATALYST ZSM-5
Ph.D. Thesis
Frank Shaw-Shyong Hwu 1981 154 p
Avail: Univ. Microfilms Order No. 8116969

The product distribution over a broad range of space velocities indicates the reaction sequence: methanol, reversible reaction dimethyl and ether yields C2-C5 olefins yields parafins and aromatics. Monomethyl aliphatics predominate over both straight-chain and dimethyl hydrocarbons. Aromatics consist mainly of toluene and xylene mixtures. At 368 C, compositions of butene isomers are in thermodynamic equilibrium, over the range of residence times investigated. Equilibrium composition of xylenes is not established until tau = 1440 mg-sec/cc; p-xylene is kinetically favored at short residence. Dissert. Abstr.

N81-31380*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFRARED SPECTROSCOPY FOR THE DETERMINATION OF HYDROCARBON TYPES IN JET FUELS
Constance S. Buchar Aug. 1981 10 p refs
(NASA-TM-82874; E-957) Avail: NTIS HC A02/MF A01 CSCL 21D

The concentration of hydrocarbon types in conventional jet fuels and synfuels can be measured using a computerized infrared spectrophotometer. The computerized spectrophotometer is calibrated using a fuel of known aromatic and olefinic content. Once calibration is completed, other fuels can be rapidly analyzed using an analytical program built into the computer. The concentration of saturates can be calculated as 100 percent minus the sum of the aromatic and olefinic concentrations. The analysis of a number of jet fuels produced an average standard deviation of 1.76 percent for aromatic types and one of 3.99 percent for olefinic types. Other substances such as oils and organic mixtures can be analyzed for their hydrocarbon content. Author

N81-31389# Exxon Research and Engineering Co., Florham Park, N.J.
EDS COAL LIQUEFACTION PROCESS DEVELOPMENT, PHASE 4. CONSTRUCTION OF EXXON COAL LIQUEFACTION PILOT PLANT Final Report
Mar. 1981 160 p Sponsored in part by DOE, Exxon Co., EPRI, Japan Coal Liquefaction Development Co., Phillips Coal Co., ARCO Coal Co., Ruhrkohle AG, and Agip S.P.A.
(Contract DE-AB01-77ET-10069)
(DOE/ET-10069/T4; FE-2893-68) Avail: NTIS HC A08/MF A01

Completion of the Exxon Coal Liquefaction Pilot Plant Program began in 1975 is detailed. The final cost of the plant was an increase of 7.3 percent over the original cost outlook. DOE

N81-31390# United Technologies Research Center, East Hartford, Conn.
EVOLUTION OF FUEL NITROGEN DURING THE VACUUM THERMAL DEVOLATILIZATION OF COAL
J. D. Freihaut and D. J. Seery 1981 18 p refs
(Contract DE-AC21-78ET-10744)
(DOE/ET-10744/T3) Avail: NTIS HC A02/MF A01

The results of an investigation of the evolution of fuel nitrogen during the vacuum thermal decomposition of coal are presented. Results are shown for variations with coal characteristics and apparent thermal history. Apparent heating rates of 75 C/sec to 2000 C/sec and final temperatures of 500 C to 1780 C were utilized, a variety of coals were investigated ranging in rank from lignite to anthracite. The results indicate that nitrogen distribution in the volatiles is a sensitive function of the chemical characteristics of the parent coal. This distribution of nitrogen in the light gas, tar and char products of vacuum devolatilized coal is highly dependent on rank of the parent coal. Variations in nitrogen evolution with coal characteristics are most readily apparent in several aspects: (1) the coal nitrogen released with the tar species; (2) the release of nitrogen contained in primary tars as HCN upon secondary thermal decomposition reactions of the primary tars; and (3) the retention of nitrogen in the char species. DOE

N81-31391# Auburn Univ., Ala.
ROLE OF NON-FERROUS COAL MINERALS AND BY-PRODUCT METALLIC WASTES IN COAL LIQUEFACTION
D. Garg, F. K. Schweighardt, E. N. Givens, J. H. Clinton, A. R. Tarrer, J. A. Guin, C. W. Curtis, and S. M. Huang Jun. 1980 110 p Prepared in cooperation with Air Products and Chemicals, Inc., Trexlertown, Pa.
(Contract DE-AC22-79ET-14806)
(DOE/ET-14806/T4) Avail: NTIS HC A06/MF A01

The thermal behavior of various minerals and metallic by product wastes was evaluated by thermal gravimetric analysis and differential thermal analysis in the presence of hydrogen, nitrogen, and air. A number of minerals were screened for catalytic activity toward coal liquefaction in a tubing bomb reactor. The catalytic activity of the minerals was assessed by comparing the product distributions both in the presence of minerals and their absence. The use of a Bronson Sonifier was initiated in March to accelerate and improve the solvent separation technique. The addition of lime to the reaction mixture practically killed the liquefaction reaction. The addition of dolomite, rutile, illite, quartz, zircon, and calcite to the reaction mixture showed no signicant improvement over that of a no additive run. The addition of zinc oxide and ilmenite showed slight improvement. Robena pyrite and Co-Mo-Al showed significant improvment in coal conversion and production of benzene solubles and gases. Iron oxide (Fe2O3) gave the highest conversion of coal and production of benzene solubles among all the minerals tested. DOE

N81-31392# Southwest Research Inst., San Antonio, Tex. Mobile Energy Div.
OPTIMIZATION OF ACCELERATED STABILITY-TEST TECHNIQUES FOR DIESEL FUELS Final Report
Leo L. Stavinoha and Steven R. Westbrook Jun. 1981 68 p refs
(Contract DE-AC19-79BC-10043)
(DOE/BC-10043/25) Avail: NTIS HC A04/MF A01

The formation of deleterious products in middle distillate fuels was studied. The results were applied to the development of more reliable test methods for fuel stability. Eight accelerated stability tests were chosen and evaluated using a set of six test fuels. Correlations of accelerated stability test results were then related to test results obtained at a storage temperature of 430 C (1100 F), which is generally regarded as showing good correlation with long-term ambient storage. Testing of eight fuels having a wide range of stabilities provided data which, when

mathematically correlated, allowed for a number of observations. Total insolubles, as opposed to total gum values, were judged to be more acceptable for data correlation in that total gum values could not be reliably corrected for initial gum values.DOE

N81-31396# Union Carbide Corp., Tarrytown, N.Y.
COTHANE, METHANE FROM WASTE CO Final Technical Report
J. A. Rabo, A. C. Frost, L. F. Elek, A. P. Risch, and C. L. Yang Dec. 1980 117 p refs
(Contract DE-AC03-78CS-40177)
(DOE/CS-40177/T2) Avail: NTIS HC A06/MF A01

As the result of early efforts in the fields of catalysis, coal gasification, and methanation, Union Carbide developed a process for the direct concentration and conversion of CO in dilute waste streams to high quality methane (SNG). This two bed, two step process was dubbed COthane, a contraction of the feed carbon monoxide (CO) and the product methane. The objectives of this contract were to develop the COthane process up to the large pilot plant stage, to develop an improved catalyst, and to estimate the cost of methane produced by this process. The process development studies yielded all of the design parameters required to design a large scale pilot plant, the catalyst development program produced a catalyst with promising stability, and the economic studies showed that methane production cost would generally be more than $6/MM Btu. Because this cost is above those for natural gas, further work on this project was suspended until rising natural gas prices catch up with the more slowly rising COthane production cost. DOE

N81-31397# New Hampshire Univ., Durham.
ALTERNATE FUELS MANUFACTURED FROM HIGH TEMPERATURE SOLAR THERMAL SYSTEMS Technical Annual Progress Report, 1 Apr. 1980 - 31 Mar. 1981
1981 15 p refs
(Contract DE-AC02-79ET-21067)
(DOE/ET-21067/2) Avail: NTIS HC A02/MF A01

A feasibility study of three modes of transportation of coal and lignite is discussed. These modes are railroads, barges and slurry pipe lines. Geographical aspects and estimated costs of transporting coal are considered. The size and capacity of solar gasification plants are discussed, and locations are considered. Economic feasibility assessments for hybrid and direct solar units with respect to export potential are discussed. A bench scale fluidized-bed coal gasification unit is described, and its heat and material balances are tabulated. DOE

N81-31398# Rolls-Royce Ltd., Derby (England).
A UNITED KINGDOM VIEW ON FUTURE FUELS
A. B. Wassell 1981 7 p refs
(PNR-90068) Avail: NTIS HC A02/MF A01

It is noted that the quality of aviation fuel is expected to deteriorate as the available liquid hydrocarbon fuels become increasingly scarce. The characteristics of the fuel which are the most important from engine operational considerations are discussed. A reduction in the fuel thermal stability is likely to be the most serious problem both for fuel control and distribution systems. The aromatic content increase will require a complete design reoptimization to avoid visibility of the exhaust plume. Higher nitrogen oxide emissions will require more complex combustion systems. The increasing carbon production will lead to shorter combustor life. Exhaust visibility problems experienced between startup and ground idle are also discussed. It is shown that no single parameter will be sufficient to define fuel quality, and that design philosophies will probably be required.
Author (ESA)

N81-31399# New York State Dept. of Health, Albany. Div. of Labs. and Research.
METHANE PRODUCTION RATE STUDIES AND GAS FLOW MODELING FOR THE FRESH KILLS LANDFILLS Interim Report
C. O. Kunz and A. H. Lu Nov. 1980 83 p refs
(PB81-196552; NYERDA-80-21) Avail: NTIS HC A05/MF A01 CSCL 21D

Gas flow models were developed based on measurements of the pressure differential between landfill gas and atmospheric pressure that would enable the rate of gas production to be estimated. Two landfill gas flow models were developed: a static model and a dynamic model. GRA

N81-31400# Northrop Services, Inc., Research Triangle Park, N. C.
IMPACT OF GASOHOL ON AUTOMOBILE EVAPORATIVE AND TAILPIPE EMISSIONS
John M. Lang and Frank M. Black Apr. 1981 14 p refs Presented at the Intern. Congr. and Exposition, Detroit, 23-27 Feb., 1981
(Contract EPA-68-02-2566)
(PB81-199952; EPA-600/J-81-137) Avail: NTIS HC A02/MF A01 CSCL 21D

National interest growing in the use of gasohol, a blend of ethanol and unleaded gasoline, as an alternate fuel to gasoline, is discussed. In order to assess its viability as a transportation fuel, gasohol's impact on vehicle emissions, fuel economy, and driveability are considered, along with the cost of production and the physical compatibility of ethanol with gasoline. GRA

N81-31401# Bureau of Mines, Pittsburgh, Pa. Research Center.
DIRECT METHOD DETERMINATION OF THE GAS CONTENT OF COAL: PROCEDURES AND RESULTS
W. P. Diamond and J. R. Levine Mar. 1981 42 p refs
(PB81-196735; BM-RI-8515; BMRI-1981) Avail: NTIS HC A03/MF A01 CSCL 08I

The explosion hazard of methane-air mixtures has become an increasingly serious mine planning problem and an advance assessment of methane gas potential can therefore be essential for a safe and economic mine development program. As part of its coal mine health and safety program, the Bureau of Mines has developed a simple, inexpensive test to measure the methane content of coal samples obtained from exploration cores. The gas content of coal per unit weight as determined by the direct method test can be used as a basis for a preliminary estimate of mine ventilation requirements, and to determine if degasification of the coalbed in advance of mining should be considered. GRA

N81-31609# California Dept. of Conservation, Sacramento. Div. of Mines and Geology.
RESOURCE ASSESSMENT OF LOW- AND MODERATE-TEMPERATURE GEOTHERMAL WATERS IN CALISTOGA, NAPA COUNTY, CALIFORNIA. REPORT OF THE SECOND YEAR, 1979 TO 1980 OF THE US DEPARTMENT OF ENERGY - CALIFORNIA STATE-COUPLED PROGRAM FOR RESERVOIR ASSESSMENT AND CONFIRMATION
L. G. Youngs, C. Forrest Bacon, Rodger H. Chapman, Gordon W. Chase, Chris T. Higgins, Hasmukhrai H. Majmundar, and Gary C. Taylor 10 Nov. 1980 522 p refs
(Contract DE-FG03-79ET-27035)
(DOE/ET-27035/T1) Avail: NTIS HC A22/MF A01

Statewide assessment studies included updating and completing the USGS GEOTHERM File for California and compiling all data needed for a California Geothermal Resources Map. The Calistoga effort was comprised of a series of studies involving different disciplines, including geologic, hydrologic, geochemical and geophysical studies. DOE

N81-31611# Los Alamos Scientific Lab., N. Mex.
HOT DRY ROCK GEOTHERMAL POTENTIAL OF ROOSEVELT HOT SPRINGS AREA: REVIEW OF DATA AND RECOMMENDATIONS
Jennifer East May 1981 46 p refs
(Contract W-7405-eng-36)
(LA-8751-HDR) Avail: NTIS HC A03/MF A01

The Roosevelt Hot Springs area in west-central Utah possesses several features indicating potential for hot dry rock (HDR) geothermal development. The area is characterized by extensional tectonics and a high regional heat flow of greater than 105 mW/m(2). The presence of silicic volcanic rocks as young as 0.5 to 0.8 Myr and totaling 14 km(3) in volume indicates underlying magma reservoirs may be the heat source for the thermal anomaly. Several hot dry wells have been drilled on the periphery of the geothermal field. Information obtained on three of these deep wells shows that they have thermal gradients of 55 to 60DC/km and bottom in impermeable Tertiary granitic and Precambrian gneissic units. The Tertiary granite is the preferred HDR reservoir rock because Precambrian gneissic rocks possess a well-developed banded foliation, making fracture control over the resevoir more difficult. Based on a fairly conservative estimate of 160 km(2) for the thermal anomaly present at Roosevelt Hot Springs, the area designated favorable for HDR geothermal exploration may be on the order of seven

times or more than the hydrogeothermal area currently under development.
DOE

N81-31645# Republic Geothermal, Inc., Santa Fe Springs, Calif.
CO2 AND CARBONATE CHEMISTRY APPLIED TO GEOTHERMAL ENGINEERING. GUIDANCE FOR INTERPRETING AND USING CHEMICAL DATA ABOUT GEOTHERMAL RESOURCES
Donald E. Michels Jan. 1981 32 p refs
(Contract W-7405-eng-48)
(LBL-11509) Avail: NTIS HC A03/MF A01

The chemistry of high HCO3 resources is emphasized because they present complications about data interpretation, development of vapor, and potential for scale deposition. Solubility of CO2 and its exsolution from liquids is treated according to the context presented by geothermal resources. Contrasts between this approach and the treatment of CO2 solubility in physical chemistry and other geochemical contexts are presented. Dimensional units for solubility coefficients different from those of physical chemists are presented to favor engineering application. The effects of CO2 on wellbore flow, initiation of flashing, and depth of the 2-phase zone are described and illustrated with examples.
DOE

N81-31662# Systems Science and Software, La Jolla, Calif.
BACA GEOTHERMAL DEMONSTRATION PROJECT. EQUATION-OF-STATE FOR WATER-CARBON DIOXIDE MIXTURES: IMPLICATIONS FOR BACA RESERVOIR
J. W. Pritchett, M. H. Rice, and T. D. Riney Feb. 1981 57 p refs Prepared for Union Geothermal Co. of New Mexico and Public Service Co. of New Mexico
(Contract DE-FC03-78ET-27163)
(DOE/ET-27163/8) Avail: NTIS HC A04/MF A01

An equation of state package for water carbon dioxide mixtures was constructed. The thermodynamic state of the Baca reservoir fluid was examined for temperature, pressure and CO2 content for bracket conditions existing at the production depth of the wells in the Redondo Creek area. It is shown that the reservoir fluid may be either all liquid or two phase at various well locations and depths, depending on the CO2 content. It is also shown that the CO2 content at reservoir conditions cannot be reliably inferred from pressure/temperature measurements made on flowing wells. The equation of state package is incorporated into a general purpose geothermal reservoir simulator and calculations show that the CO2 content of the produced fluid is less than or greater than that of the reservoir fluid. The characteristics of the produced fluid are sensitive to the CO2 content in the reservoir.
DOE

N81-31687# Lockman and Associates, Monterey Park, Calif.
FEASIBILITY OF DIRECT ON-SITE CONVERSION OF LANDFILL GAS TO ELECTRICAL ENERGY AT SCHOLL CANYON LANDFILL, CALIFORNIA Final Report
Ronald J. Lofy Jun. 1981 55 p
(Contract DE-AC01-79CS-20237)
(DOE/CE-20237/1) Avail: NTIS HC A04/MF A01

The technical and economic feasibility of direct onsite conversion of landfill gas into electrical energy for distribution through the municipal company's distribution grid is described. The various approaches are evaluated. Each system looked at the preliminary collection system layout, type of processing, and conversion equipment required, conversion efficiencies, total system costs, total energy output per input landfill gas, and overall economic comparisons between alternatives. This led to the selection of the internal combustion engine. The legal constraints on interdepartmental transfers of money and resources, city procedures for coordination between the public works department and public services, procedures for facility operation, and an environmental assessment of each alternative were investigated.
DOE

N81-31791# AeroVironment, Inc., Pasadena, Calif.
ASSESSING THE LOCAL WINDFIELD WITH INSTRUMENTATION
T. G. Zambrano Oct. 1980 281 p refs Prepared for Battelle Pacific Northwest Labs., Richland, Washington
(Contract DE-AC06-76RL-01830)
(PNL-3622) Avail: NTIS HC A13/MF A01

A technique for the initial screening and evaluation of potential sites for wind energy conversion systems (WECS) was examined. The siting exercise involved measurements of winds along the surface and winds aloft using a relatively new instrument system, the tethered aerodynamic lifting anemometer (TALA) kite; notation of ecological factors such as vegetation flagging, soil erosion and site exposure, and verification of an area best suited for wind energy development by establishing and maintaining a wind monitoring network. The siting exercise was carried out in an approximately 100 square mile region. It is shown that a comprehensive site survey involves field measurements, ecological survey, and wind monitoring is an effective tool for preliminary evaluation of WECS sites.
DOE

N81-31792# Battelle Pacific Northwest Labs., Richland, Wash.
SOME ASPECTS OF FLUCTUATING VERTICAL WIND SHEARS
J. C. Doran May 1981 29 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3771) Avail: NTIS HC A03/MF A01

Fluctuating vertical shears of wind speed were measured using an array of towers. The statistical distributions of these shears are compared with Fichtl's formulas. A comparison of Fichtl's formula for the standard deviation of the fluctuating shears with the more empirical one by Ramsdell shows that the latter is consistent with the former. The probability of occurrence of extreme shears in speed is discussed. Fluctuating shears in speed is discussed. Fluctuating shears two or more times larger than the mean values are shown to be readily obtainable, and their likelihood increases as the mean measuring height increases if (RADICAL) Z is held fixed.
DOE

N81-32089# EMCON Associates, San Jose, Calif.
FEASIBILITY STUDY: UTILIZATION OF LANDFILL GAS FOR A VEHICLE FUEL SYSTEM, ROSSMAN'S LANDFILL, CLACKAMUS COUNTY, OREGON
Jan. 1981 206 p refs Sponsored in cooperation with Cal Recovery Systems, Inc. and Gas Recovery Systems, Inc.
(Contract DE-FG01-80RA-50366)
(DOE/RA-50366/T1) Avail: NTIS HC A10/MF A01

The technical and economic feasibility of recovering the methane generated in the landfill for the refueling of vehicles is examined. The expected methane yield and the development of a conceptual gas gathering system, gas processing, compressing, and storage systems, and methane fueled vehicle systems are among the factors addressed. Cost estimates made for each area of study are given. Reasoning that gasoline prices will continue to rise and that approximately 18,000 vehicles in the US have been converted to operate on methane, a project is proposed to use this landfill as a demonstration site to produce and process methane and to fuel a fleet (50 to 400) vehicles with the gas produced in order to obtain performance and economic data on the systems used from gas collection through vehicle operation.
DOE

N81-32216# Solar Turbines International, San Diego, Calif.
MECHANISMS OF FOULING, SLAGGING AND CORROSION BY PULVERIZED COAL COMBUSTION Quarterly Technical Progress Report, 11 Mar. - 30 Jun. 1981
M. E. Gulden, L. L. Hsu, and A. R. Stetson Jul. 1981 52 p refs
(Contract DE-AC22-81PC-40272)
(DOE/PC-40272/T1; SR81-R-4930-05; QTPR-1) Avail: NTIS HC A04/MF A01

Progress is reported on a program in which the objective is to conduct a mechanisms of fouling, slagging and corrosion in pulverized coal combustors by employing. Emphasis is on design and construction of the combustion test rig. All design phases are complete. Construction of the diffuser and test sections is also complete.
DOE

N81-32223# State Univ. of New York at Buffalo School of Engineering and Applied Science.
CATALYTIC COMBUSTION OF SYNTHETIC FUELS Annual Report, 1 Aug. 1980 - 31 Jul. 1981
Lawrence A. Kennedy and Eli Ruckenstein 1981 20 p refs
(Grant DE-FG22-80PC-30220)
(DE81-027555; DOE/DC-30220/T2) Avail: NTIS HC A02/MF A01

During the period August 1, 1980 to July 31, 1981, the efforts on this project were directed towards three goals: (1) catalyst development; (2) preliminary measurements of fuel bound nitrogen conversion; and (3) design of a droplet injector

and vaporization section for use with synthetic liquids. Chromium oxides, magnesium oxide, cobalt oxides, manganese oxides, and iron oxides were examined for possible use as stable catalysts. As a result of the experiments, Cr2O3:CO3O4 mixtures with concentrations greater than 3% were chosen for catalyst in the Task II experiments. The reduction of nitrogen oxide emission from combustion sources is currently an area of major interest. The objective of the experiment was to study the oxidation of a nitrogen bound fuel over a binary transition metal oxide catalyst. Argon-oxygen is the oxidizing gas. Propane doped with nitrogen gas will also be tested in the catalytic combustor. DOE

N81-32225# Department of Energy, Morgantown, W. Va. Energy Technology Center.
COMBUSTION OF WESTERN COAL IN A FLUIDIZED BED
W. T. Abel, R. L. Rice, J. Y. Shang, D. G. Turek, and W. J. Ayers Jul. 1981 32 p refs
(DE81-028103; DOE/METC-RI/178) Avail: NTIS HC A03/MF A01

Subituminous coals amount to over 25% of the Nation's coal reserves and are located in dry areas. Fluidized-bed combustion (FBC) offers a clean stack gas without additional water requirement. A western subituminous coal from the Rosebud mine in Montana was burned in the 18-in diameter FBC unit at the Morgantown Energy Technology Center to investigate its potential as an FBC fuel. In this study, bed temperature ranged from about 1450 to 1670 F and fluidizing air velocity ranged from 2.6 to 4 t per second. The investigation included operating characteristics, SO2 emission with and without added limestone, distribution of solids and solid components throughout the system; other pertinent data are reported. Sulfur retention was greatest at lower bed temperatures (1450O F). It was concluded that: sulfur dioxide emission can be kept below the EPA limit of 1.2 lb/10(6) Btu without any added sorbent for bed temperatures below 1500 F; more stringent limits may require the addition of limestone. The NO/sub x/ emission limit of 0.6 lb NO2/10(6) Btu is met with excess air up to 25% and bed temperatures to 16700 F. DOE

N81-32226# Air Products and Chemicals, Inc., Allentown, Pa.
CRYOGENIC METHANE SEPARATION/CATALYTIC HYDROGASIFICATION PROCESS ANALYSIS Quarterly Report
J. Klosek 13 Feb. 1981 9 p refs
(Contract DE-AC01-78ET-10325)
(DOE/ET-10325/T6) Avail: NTIS HC A02/MF A01

Combinations of acid gas removal, methane separation for the Exxon Catalytic Coal Gasification, and the Rockwell/Cities Service Hydrogasification processes were investigated with emphasis on the effect of variations of design parameters on the treatment cost of the SNG produced. Heat and material balance and equipment sizing was completed for the cryogenic methane separation. The overall material balance is presented in a table. Preliminary designs for MEA and DEA gas removal systems were established. The SNG product compressor train was simulated for the case where sufficient SNG fuel is withdrawn from the product compressors to fire the dryer reactivation heater. Acid gas removal and cryogenic separation equipment was resized to accommodate Exxon's request for a two-train plant design. DOE

N81-32227# Air Products and Chemicals, Inc., Allentown, Pa.
CRYOGENIC METHANE SEPARATION/CATALYTIC HYDROGASIFICATION PROCESS ANALYSIS Quarterly Report
J. Klosek May 1981 39 p refs
(Contract DE-AC01-78ET-10325)
(DOE/ET-10325/T8) Avail: NTIS HC A03/MF A01

The objective of this coordinated research program is optimization of the Rockwell/Cities Service Short Residence Time Hydrogasification (SRTH) and the Exxon Catalytic Coal Gasification (CCG) processes in the acid gas removal and cryogenic areas. Progress reports of eight subtasks are presented along with process flowsheets, heat and material balances and economic evaluation, summarized in tables. Each subtask studied the effect of variation of a key design parameter on the treatment cost of the SNG produced. DOE

N81-32229# Los Alamos Scientific Lab., N. Mex.
CHEMICAL-EQUILIBRIUM CALCULATIONS FOR AQUEOUS GEOTHERMAL BRINES
Jerry F. Kerrisk May 1981 22 p refs
(Contract W-7405-eng-36)
(DE81-026802; LA-8851-MS) Avail: NTIS HC A02/MF A01

Results from four chemical-equilibrium computer programs, REDEQL:EPAK, GEOCHEM, WATEQF, and SENECA2, were compared with experimental solubility data for some simple systems of interest with geothermal brines. Seven test cases involving solubilities of CaCO3, amorphous SiO2, CaSO4, and BaSO4 at various temperatures from 25 to 300 C and in NaCl or HCl solutions of 0 to 4 molal were examined. Significant differences between calculated results and experimental data occurred in some cases. These differences were traced to inaccuracies in free-energy or equilibrium-constant data and in activity coefficients used by the programs. Although currently available chemical-equilibrium programs can give reasonable results for these calculations, considerable care must be taken in the selection of free-energy data and methods of calculating activity coefficients. DOE

N81-32232# Los Alamos Scientific Lab., N. Mex.
APPLICATION OF CRYOGENIC SPECTROSCOPY TO THE DETERMINATION OF IMPURITY CONCENTRATION IN COAL GASIFIERS
R. F. Holland and G. P. Quigley 1981 18 p refs Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, San Francisco, 8-10 Jun. 1981
(Contract W-7405-eng-36)
(DE81-025410; CONF-810607-9; LA-UR-81-1736) Avail: NTIS HC A02/MF A01

A number of small molecules are soluble at low-to-moderate concentrations in the ir-transparent liquefied rare gases. As part of an effort to develop methods to measure concentrations of minor constituents in product gases from coal gasifiers, measurements were made of the infrared spectral absorbance of solutions produced by sampling cryogenically a mixture of gases and dissolving the sample in liquid xenon. Observations thus far include CO2, CO, CH4, and H2 as major constituents and NO2, NO, NH3, N2O, SO2, and COS as minor constituents in the mixture. For low concentrations in the cold solutions, solute absorption bands are narrow, with widths at half-maximum absorbance of 1 to 10 per cm compred with approximately 30 to 100 per cm for the gas phase. The band-narrowing enhances peak absorbance and reduces spectral overlapping for easier analysis of complex mixtures. In the sampling, we remove most CO and CH4, so that only the CO2 interferes with the spectrum of minor constituents. DOE

N81-32267# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
CORROSION AND STRESS CORROSION CRACKING IN COAL LIQUEFACTION PROCESSES
V. B. Baylor and J. R. Keiser 1980 56 p refs Presented at the Canadian Council of ASM Conf. on Materials to Satisfy Energy Demand, Harrison, UK, 11 May 1980
(Contract W-7405-eng-26)
(CONF-8005172-1) Avail: NTIS HC A04/MF A01

The liquefaction of coal to produce clean burning synthetic fuels was demonstrated at the pilot plant level. However, some significant materials problems must be solved before scale up to commercial levels of production can be completed. Failures due to inadequate materials performance were reported in many plant areas; in particular, stress corrosion cracking was found in austenitic stainless steels in the reaction and separation areas and several corrosion observed in fractionation components. In order to screen candidate materials of construction, racks of U-bend speciments in welded and as-wrought conditions and unstressed surveillance coupons were exposed in pilot plant vessels and evaluated. Failed components were analyzed on site and by subsequent laboratory work. DOE

N81-32289*# Spectra Research Systems, Inc., Huntsville, Ala.
TECHNOLOGY AND DEVELOPMENT REQUIREMENTS FOR ADVANCED COAL CONVERSION SYSTEMS Final Report
Aug. 1981 151 p refs
(Contract NAS8-34264)
(NASA-CR-161853; SRS/SE-TR81-102) Avail: NTIS HC A08/MF A01 CSCL 21D

A compendium of coal conversion process descriptions is presented. The SRS and MC data bases were utilized to provide information paticularly in the areas of existing process designs

and process evaluations. Additional information requirements were established and arrangements were made to visit process developers, pilot plants, and process development units to obtain information that was not otherwise available. Plant designs, process descriptions and operating conditions, and performance characteristics were analyzed and requirements for further development identified and evaluated to determine the impact of these requirements on the process commercialization potential from the standpoint of economics and technical feasibility. A preliminary methodology was established for the comparative technical and economic assessment of advanced processes. T.M.

N81-32296# Research Triangle Inst., Research Triangle Park, N. C.
VEGETABLE OILS AS AN ON THE FARM DIESEL FUEL SUBSTITUTE: THE NORTH CAROLINA SITUATION Final Report
Hendrick J. Harwood Jun. 1981 70 p refs
(DE81-903452; NCEI-0032; FR-41U-1671-4) Avail: NTIS HC A04/MF A01

The state-of-the-art of using vegetable oil as a diesel fuel alternative is reviewed. Particular emphasis has been placed on using vegetable oil in farm vehicles as an emergency fuel which may be produced on-farm. The following are reviewed: the mechanical feasibility, on-farm fuel production, and economic analysis. DOE

N81-32301# Pritchard Corp., Kansas City, Mo.
EVALUATION OF THE USE OF UCG GAS TO PRODUCE 4000 BPD AND 12,000 BPD OF METHANOL WITH CONVERSION TO M-GASOLINE
[1981] 150 p
(Contract DE-AC01-80ET-14372)
(DOE/ET-14372/T1) Avail: NTIS HC A07/MF A01

It is possible to convert an existing ammonia plant into a methanol facility. Existing ammonia and methanol plants which contain equipment that might be utilized with UCG all use natural gas for feedstock. The processing steps in these plants can be divided into unit operations which are described. The product price analysis shows that significant economies of scale exist for the larger of the two facility sizes considered in this study. The economies of scale are evident for both the methanol/M-gasoline and methanol-only facilities. Compared to current market prices, the calculated product prices for the 4000 BPD and 12,000 BPD methanol-only facilities are within the range of competitiveness with the prices of conventionally produced methanol. The product prices calculated for the 12,000 BPD methanl/4910 BPD M-gasoline facility are, under the most optimistic assumptions, 50 percent higher than the current market price for unleaded gasoline. DOE

N81-32302# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Technical Div.
NATURAL GAS AND METHANE AS VEHICLE FUELS AT SRP
J. L. Steimke 9 Mar. 1981 11 p refs
(Contract DE-AC09-76SR-00001)
(DPST-80-634) Avail: NTIS HC A02/MF A01

The practicality of altering the 700 gasohol-consuming vehicles in the Savannah River Fleet to run on compressed gas or methane is examined. Pipeline natural gas would be purchased or water hyacinths could be grown in ponds at SRP and anaerobically digested to generate methane. Conversion of vehicles to natural gas using a kit, safety considerations, fuel characteristics of natural gas, and costs of converting to natural gas fuel are briefly discussed. The production procedures for hyacinths, the mass that would be required, the water acreage and fertilizers needed, harvesting and transport expenses, operation and performance of the digester, and yields from the digester are also discussed briefly. In sum, it is economically attractive to fuel plant vehicles with natural gas and technically feasible to utilize hyacinths to generate methane, but expensive. DOE

N81-32303# Gulf Research and Development Co., Pittsburgh, Pa. Chemical and Materials Div.
SOLVENT REFINED COAL (SRC) PROCESS: SELECTED PHYSICAL, CHEMICAL, AND THERMODYNAMIC PROPERTIES OF NARROW BOILING RANGE COAL LIQUIDS FOR THE SRC-2 PROCESS Interim Report, Mar. 1980 - Feb. 1981
J. A. Gray Apr. 1981 224 p refs
(Contract DE-AC05-76ET-10104)
(DE81-025929; DOE/ET-10104/7) Avail: NTIS HC A10/MF A01

Physical, chemical, and thermodynamic properties of coal liquids as a function of boiling range via the pseudocomponent approach are needed for process design now that various direct coal liquefaction processes are being scaled to semi-commercial size. Products from the SRC-II processing of a high volatile bituminous coal were distilled into narrow boiling fractions with average boiling points ranging up to 9890 F. Fractions boiling below 7500 F typically spanned a 500 F interval, while the others were slightly wider boiling and overlapped somewhat. Liquid density, thermal conductivity and viscosity were measured at temperatures to 4500 F, and specific heat was determined at temperatures near the boiling point of each fraction. Other property determinations included molecular weight, pour point, elemental analyses, water content and solubility and hydrocarbon types. Both organic oxygen content and water solubility showed a pronounced maximum for the fraction having an average boiling point of 3840 F. DOE

N81-32304# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy Systems Div.
COAL-HYDROGASIFICATION PROCESS DEVELOPMENT Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981
L. P. Combs, L. S. Breese, N. J. Patel, M. P. Garey, and W. T. Lee Jul. 1981 36 p refs
(Contract DE-AC01-78ET-10328)
(DOE/ET-10328/33) Avail: NTIS HC A03/MF A01

Principal IPDU-related activities concerned advance procurement of components and equipment for eventual facility construction and the addition of a benzene recovery loop to the product gas system. Equipment specifications and envelope control drawings were prepared for components needed for the benzene recovery loop. Facility design modifications to accommodate this system addition are being worked upon. Development of a computer code for modeling the fluid mechanics, particle dynamics, and coal pyrolysis chemistry within an entrained flow coal FHP reactor was continued. Most of the effort was devoted to: incorporating the expanded coal particle pyrolysis and chemical kinetic reaction model into the entrained flow reactor model; modifying the numerical solution method to one more suitable for the expanded set of model differential equations; debugging the computer code; and evaluating computer run options for most reliable and economical computation. Attention was also directed to comparing conversions calculated by the new FHP reactor model with experimental conversions from ten selected hydrogasification and hydroliquefaction tests having a broad range of reactor residence times. DOE

N81-32306# New York State Energy Research and Development Authority, New York.
LOW/MEDIUM Btu COAL GASIFICATION ASSESSMENT PROGRAM FOR SPECIFIC SITES OF TWO NEW YORK UTILITIES. EXECUTIVE SUMMARY
Dec. 1980 31 p refs
(Contract DE-FG01-79RA-20223)
(DE81-027682; DOE/FE-20223/1) Avail: NTIS HC A03/MF A01

The technical and economic aspects of coal gasification to supply low or medium Btu gas to two power plant boilers were investigated. This includes the following: select a coal based on its availability, mode of transportation and delivered cost to each power plant site; investigate the effects of burning low and medium Btu gas in the selected power plant boilers based on efficiency, rating, and cost of modifications and make recommendations for each; review the technical feasibility of converting the power plant boilers to coal derived gas; and identify coal gasification systems that are compatible with the selected coals. The technical feasibility of designing a coal gasification facility to meet the constantly changing fuel demands of a power plant are reviewed. Gas cleanup systems that are available and compatible with the gasification systems, and capable of reducing the total sulfur emission levels to that required by environmental regulations are identified and regulatory and financial aspects of conversion to a coal derived gas were considered. Cost estimates for each of the coal gasification systems, for the boiler modifications, and for each of the synthetic gas fired options are given and compared to the case of continued oil firing. DOE

N81-32308# California Univ., Livermore. Lawrence Livermore Lab.
HIGH-PRESSURE SOLVENT EXTRACTION OF METHANE FROM GEOPRESSURED BRINES: TECHNICAL EVALUATION AND COST ANALYSIS
R. Quong, H. H. Otsuki, and F. E. Locke Jul. 1971 29 p refs
(Contract W-7405-eng-48)
(UCID-19090; DE81-027837) Avail: NTIS HC A03/MF A01

Solvent extraction is proposed as a means of recovering dissolved methane from geopressured-geothermal brines at high pressures. The assessment shows that additional investment in a high pressure solvent extraction plant proceding direct injection disposal of brines into isolated aquifers can be profitable. The technical and economic issues are discussed, and compared with other injection methods such as complete depressurization for methane recovery followed by conventional mechanical pumping. The contributions of hydraulic (pressure) energy recovery and geothermal power production are also assessed. For deep injection into the producing formation, it is concluded that methane extraction processes are not applicable, insofar as maintenance of high surface pressures provides no clear-cut energy benefits. As a first step in the evaluation of solvent extraction, the solubility of a promising solvent candidate, n-hexadecane, was measured in 15 wt % NaCl solutions at temperatures 2 Diesel fuel, was also measured. DOE

N81-32310# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy Systems Group.
MHD COAL COMBUSTOR TECHNOLOGY Final Report
Sep. 1980 213 p refs
(Contract DE-AC22-78ET-11054)
(DE81-025513; DOE/ET-11054/T1) Avail: NTIS HC A10/MF A01

The design, performance, and testing of a 20-MW coal combustor for scaleup to 50 MW for use in an MHD generator are described. The design incorporates the following key features: (1) a two-stage combustor with an intermediate slag separator to remove slag at a low temperature; (2) a first-stage pentad (four air streams impinging on one coal stream) injector design with demonstrated efficient mixing; (3) a two-section first-stage combustion chamber; the first stage using a thin slag-protected refractory layer and the second section using a thick refractory layer; (4) a refractory lining in the slag separator to minimize heat losses; (5) a second-stage combustor; (6) a dense-phase coal feed system to minimize cold carrier gas entering the first-stage combustors; (7) a dry seed injection system using pulverized K2CO3 with a 1% amorphous, fumed silicon dioxide additive; and (8) a performance evaluation module of rugged design based on an existing, successfully-fired unit. DOE

N81-32312# Oak Ridge National Lab., Tenn. Fossil Energy Materials Program Office.
ADVANCED RESEARCH AND TECHNOLOGY DEVELOPMENT FOSSIL ENERGY MATERIALS PROGRAM PLAN FOR FY 1981
R. A. Bradley, comp. and R. R. Judkins, comp. Jul. 1981 179 p refs
(Contract W-7405-eng-26)
(DE81-025776; ORNL/TM-7812) Avail: NTIS HC A09/MF A01

Background, technical issues, and needed fossil energy programs are discussed. The major focus is on coal mining, cleaning, beneficiation, and handling; MHD; and information storage and technology transfer. DOE

N81-32313# Aluminum Co. of America, Alcoa Center, Pa.
PULVERIZED COAL FIRING OF ALUMINUM-MELTING FURNACES Annual Technical Progress Report, Jul. 1979 - Jun. 1980
C. E. West and D. L. Stewart, Jr. 1980 30 p refs
(Contract DE-AC01-78CS-40037)
(DOE/CS-40037/T3; ATPR-2) Avail: NTIS HC A03/MF A01

Progress is reported on the demonstration program of an efficient, environmentally acceptable coal firing process suitable for implementation on melting furnaces in the aluminum industry. Specific tasks reported on are: design of Burner A; purchase of stack gas sampling instrumentation; process equipment and layout; purchase of process equipment; fabrication of Burner A; installation of process equipment; design of slag handling system and fabrication of slag handling system. The status report on Phase I data deliverables and amendment/modification to the contract are given. DOE

N81-32314# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum Refining Engineering.
PHASE-EQUILIBRIUM PROPERTIES OF COAL-DERIVED LIQUIDS Technical Progress Report, Jan. - Jun. 1981
V. F. Yesavage and A. J. Kidnay 1 Jul. 1981 11 p
(Contract DE-FG22-89PC-30230)
(DE81-027106; DOE/PC-30230/T2) Avail: NTIS HC A02/MF A01

On July 1, 1980, work was initiated on a program for experimental vapor liquid equilibrium measurements on coal derived liquids. During the last six months design of the equilibrium flash vaporization system was completed and all major equipment was delivered. Most of the construction work of the system was also completed. Construction and evaluation of the equipment should be completed by the end of the summer. Work was also started on the gas-liquid chromatography analytical procedures. Coal derived liquids are a new and vital class of industrial compounds for which there are limited thermodynamic data. The principal investigators have conducted a program in the measurement and correlation of the enthalpy of coal derived liquids. Programs have also been undertaken to measure volumetric properties and K values of light gas-model compounds systems and to measure new points, vapor pressures and hydrogen solubilities in model compound and coal derived liquid systems. The objective of the present study is to measure equilibrium K values of coal derived liquids and model compounds representative of coal liquids, and to use the results in the development of engineering correlations. DOE

N81-32315# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy Systems Div.
FLASH HYDROLIQUEFACTION OF COAL Quarterly Technical Progress Report, 30 Sep. 1980 - 31 Dec. 1981
A. Y. Falk Jul. 1981 40 p refs
(Contracts DE-AC22-89PC-30018; DE-AC22-76ET-10144)
(DE81-026607; QTPR-1; DOE/PC-30018/T1) Avail: NTIS HC A03/MF A01

The effectiveness of the reactor concept was demonstrated. It is clear that substantial liquid yields and high overall conversions are possible. Overall carbon conversions as high as 64 percent were obtained. Overall conversions of this level are required for balanced plant operation (complete carbon utilization) if the residual char is gasified to generate the process hydrogen. Carbon conversions to liquid products as high as 38 percent were obtained. The reactor is also sufficiently versatile to produce high carbon conversions to gases as well, with conversions as high as 82 percent having been obtained. A high-pressure product recovery system was designed and installed as part of the 1 TPH system. Forty reactor tests were conducted utilizing the new high pressure product recovery system. The new system functioned well after an initial shakedown, and they allow for better separation and recovery of the products. DOE

N81-32317# Conoco Coal Development Co., Library, Pa.
RECYCLE SLURRY-OIL CHARACTERIZATION Quarterly Report, 1 Jan. - 31 Mar. 1981
F. P. Burke and R. A. Winschel Jun. 1981 52 p refs
(Contract DE-AC22-80PC-30027)
(DE81-025230; DOE/PC-30027/9; QR-2) Avail: NTIS HC A04/MF A01

Measurement of recycle slurry and process oil characteristics are used to evaluate the relationship between coal liquid properties and process performance. Areas of process performance investigated include the following: changes in the slurry recycle and process oil stream compositions during start-up; the manner in which the process reaches steady state operation during start-up; the composition of the recycle and process oil stream during stable operation; the changes in recycle oil composition in response to planned variations in process variables; changes in recycle oil composition which cause or result from unplanned upsets in process operation; differences operating conditions; and differences in recycle and process oil compositions s a function of process feed materials. DOE

N81-32323# Avco-Everett Research Lab., Mass.
VOLATILE PRODUCTION DURING PREIGNITION COAL HEATING Quarterly Progress Report, Jan. - Mar. 1981
May 1981 24 p refs

(Contract DE-AC22-89PC-30291)
(DE81-024321; DOE/PC-30291/T1) Avail: NTIS HC A02/MF A01

Design and fabrication of the experimental system is complete. Mirror design was finalized and optical configurations established for irradiation of the test section. Diagnostic development was necessary for temperature measurement; an upgraded design of a two color pyrometer was made, and is being tested. The computer code for laser heating of the coal particles was rewritten in order to make it more cost effective and efficient. This is being used to assess the consequences of experimental operating conditions upon data output and evaluation of optimal operating conditions. DOE

N81-32324# Institute of Gas Technology, Chicago, Ill.
RELATION OF COAL PROPERTIES TO GASIFICATION REACTIVITY AND THE EFFECT OF ALKILI METAL CATALYSTS ON THE KINETICS OF COAL GASIFICATION Final Report, Jan. 1972 - Mar. 1978
Satyendra P. Nandi and James L. Johnson Nov. 1980 142 p refs
(Contract GRI-5010-322-0026)
(PB81-215212; GRI-78/0048) Avail: NTIS HC A07/MF A01 CSCL 21D

Chars derived from a large number of coal and coal maceral concentrates, varying in rank from anthracite to lignite, have been gasified in hydrogen, steam hydrogen, and synthesis gas mixtures in a thermobalance apparatus at temperatures from 1400 to 1700 F and pressures from 4 to 69 atmospheres. The reactivity factors for different coals were analyzed for possible correlation with such properties as elemental composition, petrographic properties, development of internal surface area and porosity during gasification, and concentration of exchangeable cations (sodium and calcium). A direct correlation between relative reactivity factor and the carbon content of the parent coal was established. GRA

N81-32447# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT AND DEMONSTRATION OF AN ELECTRIC HEAT PUMP FOR WASTE-HEAT RECOVERY IN INDUSTRY. DESIGN AND ANALYSIS REPORT AND ANALYSIS REPORT
W. C. Moreland, J. S. Eder, and R. W. Wolfe 30 Mar. 1981 180 p refs
(Contract DE-AC01-77CS-40327)
(DE81-028751; TR-2; DOE/CS-40327/T1) Avail: NTIS HC A08/MF A01

The output capacity of the unit is 30 x 10 to the 6th power Btu/h in the form of process steam delivered at 50 psig with 20 F superheat (318 F). A functional description of the heat pump system is given along with a thermodynamic analysis of the cycle. The various subsystems, controls, and major components are also described and a safety analysis presented. A general discussion of the important considerations involved when considering the application of a heat pump to an industrial process is given. Additional information includes an analysis of the hot gas by-pass and control of the intercooler; pressure drops in methanol piping and heat exchangers; and typical liquid nitrogen storage system information. DOE

N81-32448# Lehigh Univ., Bethlehem, Pa.
SOLID CIRCULATION AROUND A JET IN A FLUIDIZED-BED GASIFIER Final Report
Hugo S. Caram and Babu Patrose Apr. 1981 45 p refs
(Contract DE-FG01-78ET-13384)
(DOE/ET-13384-T2) Avail: NTIS HC A03/MF A01

Particle circulation in the jet region of a fluidized bed gasifier is analyzed. Particle velocities were measured at corresponding points within a jet in the two dimensional bed, using the optical fiber probe and a Laser Doppler Velocimeter (LDV). The probe measurements compare well with the LDV results in the main jet region. Particle velocities were also measured with the probe in the dense phase region of the fluidized bed where measurements were not possible using LDV. The resulting flow maps clearly indicate solids circulation patterns around jets and identify dead zones formed on the distributor plate. The entering gas jet was modeled assuming that the dense phase is entrained into the gas stream. The solid particles are then conveyed upwards along the jet penetration distance. Typical conditions for a fluidized bed combustor were used and the model includes the reactions between carbon and carbon monoxide. The results indicate that considerable reaction occurs in the gas jets entering the reactor and that they should be considered in any careful analysis of its operation. DOE

N81-32584# Energy Resources Exploration, Inc., Albuquerque, N. Mex.
GEOTHERMAL RESOURCE VERIFICATION FOR AIR FORCE BASES
Philip R. Grant, Jr. Sandia Labs. Jun. 1981 53 p refs Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789; AF Proj. 2054)
(AD-A102640; SAND-81-7123) Avail: NTIS HC A04/MF A01 CSCL 10/2

Geothermal energy offers a potential alternative to oil and gas for supplying the stationary energy requirements of military installations. However, because of the past dominance of oil and gas, procedures for estimating geothermal energy potential have not been well defined nor well tested. This report summarizes the various types of geothermal energy, reviews some legal uncertainties of the resource and then describes a methodology to evaluate geothermal resources for applications to U.S. Air Force bases. Estimates suggest that exploration costs will be $50-300,000, which, if favorable, would lead to drilling a $500,000 exploration well. Successful identification and development of a geothermal resource could provide all base, fixed system needs with an inexpensive, renewable energy source. Author (GRA)

N81-32589# California Univ., Berkeley. Energy and Environment Div.
GEOPRESSURED GEOTHERMAL RESOURCE OF THE TEXAS AND LOUISIANA GULF COAST: A TECHNOLOGY CHARACTERIZATION AND ENVIRONMENTAL ASSESSMENT
Anthony Usibelli, Peter Deibler, and Jayant Sathaye Dec. 1980 259 p refs
(Contract W-7405-eng-48)
(DE81-028905; LBL-11539) Avail: NTIS HC A12/MF A01

Two aspects of the Texas and Louisiana Gulf Coast geopressured geothermal resource: the technological requirements for well drilling, completion, and energy conversion, and the environmental impacts of resource exploitation are examined. The information comes from the literature on geopressured geothermal research and from interviews and discussions with experts. The technology characterization section emphasizes those areas in which uncertainty exists and in which further research and development is needed. The environmental assessment section discusses all anticipated environmental impacts and focuses on the two largest potential problems which are subsidence and brine disposal. DOE

N81-32591# Midwest Research Inst., Golden, Colo. Agriculture Group.
BIOMASS FEEDSTOCKS FOR PETROCHEMICAL MARKETS: AN OVERVIEW AND CASE STUDY
Silvio J. Flaim, Andrew M. Hill (Pace Co. Consultants and Engineers, Inc.), and Dan Lippe May 1981 108 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-027281; SERI/TR-734-762) Avail: NTIS HC A06/MF A01

A method of analysis was developed identifying several target chemicals for potential biomass feedstock substitution. An overview of the petroleum/petrochemical industries is presented and a general discussion of refinery trends. A case study of methanol production for formaldehyde manufacturing is presented. The technical, economic, and market implications of producing biomass-derived methanol for formaldehyde manufacturing appear highly favorable. General discussions of market and economic factors (e.g., supply and demand) for all petrochemicals with emphasis on the identified target chemicals are presented. DOE

N81-32603# Pennsylvania Univ., Philadelphia. School of Public and Urban Policy.
ECONOMIC ANALYSIS OF GEOPRESSURED RESOURCES: SITE SPECIFIC CONSIDERATION OF GEOPRESSURED METHANE GAS AT BRAZORIA Final Report, 1 Mar. 1980 - 28 Feb. 1981
Apr. 1981 98 p refs
(Contract DE-AS08-80NV-10089)

(DE81-027193; DOE/NV-10089-1) Avail: NTIS HC A05/MF A01

The project quantitatively evaluates the relative effectiveness of a number of financial incentives and other public policy initiatives designed to accelerate the commercialization of geopressured resources. Results are reported including: a review of current estimates of important resource parameters at the Austin Bayou Project, initial cash flow simulations of development of the Austin Bayou Prospect, sensitivity analysis of these simulations and evaluation of the uncertainties impact on measures of profitability and investment decision analysis, and a brief review of the well-testing program. DOE

N81-32603*# United Technologies Research Center, East Hartford, Conn.

CATALYTIC COMBUSTION WITH INCOMPLETELY VAPORIZED RESIDUAL FUEL Final Report

Thomas J. Rosfjord Mar. 1981 65 p refs

(Contract DEN3-152; DE-AI01-77ET-10350)

(NASA-CR-165161; DOE/NASA/0152-1; OTRC-RB1-914/24-18) Avail: NTIS HC A04/MF A01 CSCL 10A

Catalytic combustion of fuel lean mixtures of incompletely vaporized residual fuel and air was investigated. The 7.6 cm diameter, graded cell reactor was constructed from zirconia spinel substrate and catalyzed with a noble metal catalyst. Streams of luminous particles exited the rector as a result of fuel deposition and carbonization on the substrate. Similar results were obtained with blends of No. 6 and No. 2 oil. Blends of shale residual oil and No. 2 oil resulted in stable operation. In shale oil blends the combustor performance degraded with a reduced degree of fuel vaporization. In tests performed with No. 2 oil a similar effect was observed. E.A.K.

N81-32656# Agua Caliente Trailer Park, Nev.

GEOTHERMAL HEATING FOR CALIENTE, NEVADA Final Report

Ferg Wallis and John Schaper (Grover C. Dils Medical Center, Caliente, Nev.) Feb. 1981 29 p Submitted for publication

(Contract DE-FG03-78SF-01975; Grant EM-78-G-03-1975)

(DE81-027821; DOE/SF-01975/T1) Avail: NTIS HC A03/MF A01

Geothermal heating for a trailer park and a hospital is discussed. The results from test wells for the trailer park indicate sustainable temperatures of 1400 to 1600 F. Three wells were drilled to supply all 53 trailers with domestic hot water heating, 11 trailers with space heating and hot water for the laundry from the geotherma resources. System payback in terms of energy cost-savings is estimated at less than two years. A geothermal well was drilled for the hospital and the hot water piped through a heat changer to preheat air for space heating. This geothermal preheater served to convert the existing forced air electric furnace to a booster system. It is estimated that the hospital will save an average of $5300 in electric bills per year, at the current rate of $.0275/KWH. This represents a payback of approximately two years. Subsequent studies on the geothermal resource base in Caliente and on the economics of district heating indicate that geothermal may represent the most effective supply of energy for Caliente. DOE

N81-32673# Oklahoma State Univ., Stillwater. Engineering Energy Lab.

SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 8: WIND ENERGY

William L. Hughes, R. G. Ramakumar, and Dan D. Lingelbach Apr. 1981 143 p refs Prepared in cooperation with Univ. of Central Florida, Orlando

(DE81-029009; DOE/CS-30278/T10) Avail: NTIS HC A07/MF A01

A historical perspective of wind energy utilization, and the potential uses of wind were examined and the economic costs and technical difficulties of using it. The statistical characteristics of the wind for a moderate to high wind area in the United States are discussed. Information on average available energy on an annual basis is presented along with approximately monthly variations. An extensive variety of types of windmills, and a sampling of these varieties is discussed. Data on efficiencies and power coefficients for a variety of turbines are also presented. DOE

N81-32881*# Intergraph Corp., Huntsville, Ala.

IGDS/TRAP INTERFACE PROGRAM (ITIP). SOFTWARE USER MANUAL (SUM)

Steve Jefferys, Wendell Johnson, Robert Lewis, and Ralph Rich 18 Sep. 1981 39 p

(Contract NAS8-34279)

(NASA-CR-161857) Avail: NTIS HC A03/MF A01 CSCL 09B

This specification establishes the requirements, concepts, and preliminary design for a set of software known as the IGDS/TRAP Interface Program (ITIP). This software provides the capability to develop at an Interactive Graphics Design System (IGDS) design station process flow diagrams for use by the NASA Coal Gasification Task Team. In addition, ITIP will use the Data Management and Retrieval System (DMRS) to maintain a data base from which a properly formatted input file to the Time-Line and Resources Analysis Program (TRAP) can be extracted. This set of software will reside on the PDP-11/70 and will become the primary interface between the Coal Gasification Task Team and IGDS, DMRS, and TRAP. The user manual for the computer program is presented. Author

N81-33246* National Aeronautics and Space Administration. Pasadena Office, Calif.

COAL DESULFURIZATION Patent

George C. Hsu, inventor (to NASA) (JPL, California Inst. of Technology, Pasadena) Issued 27 Mar. 1981 5 p Filed 16 Feb. 1978 Supersedes N78-33164 (16 - 24, p 3185) Sponsored by NASA

(NASA-Case-NPO-14272-1; US-Patent-4,146,367; US-Patent-Appl-SN-878253; US-Patent-Class-44-1R; US-Patent-Class-44-2; US-Patent-Class-201-17) Avail: US Patent and Trademark Office CSCL 07D

Organic sulfur is removed from coal by treatment with an organic solution of iron pentacarbonyl. Organic sulfur compounds can be removed by reaction of the iron pentacarbonyl with coal to generate CO and COS off-gases. The CO gas separated from COS can be passed over hot iron fillings to generate iron pentacarbonyl.

Official Gazette of the U.S. Patent and Trademark Office

N81-33255# Aerojet Energy Conservation Co., Sacramento, Calif.

COMBUSTION ENHANCEMENT AND POLLUTANT CONTROL RESEARCH WITH ACOUSTICALLY INDUCED MIXING Technical Progress Report, Mar. - Jun. 1981

R. J. Faeser and M. I. Rudnicki Jul. 1981 22 p refs

(Contract DE-AC22-81PC-40270)

(DE81-027016; DOE/PC-40270/1) Avail: NTIS HC A02/MF A01

An experimental research program was initiated to evaluate the possibility that beneficial effects can result when acoustic energy is impressed on the combustion zone of pulverized coal furnaces. Those benefits include the reduction in NO/sub x/ generation, the increase in combustion intensity, and the increase in turndown ratio (maximum flow/minimum flow). The postulated reason for these possible benefits is the fine stirring action of high frequency acoustic waves. The first three month period of this program was devoted to the formulation of a test plan, the design of the 5 lb/hr coal rate combustor with acoustic driver attachments, and the specification of the test facility. DOE

N81-33258# Occidental Research Corp., Irvine, Calif.

CONTROLLED FLASH PYROLYSIS Quarterly Technical Progress Report, Jan. - Mar. 1981

K. Durai-Swamy, S. C. Che, C. B. Chen, R. Jain, S. S. Kim, and H. VonSchonfeldt Apr. 1981 31 p refs

(Contract DE-AC22-80PC-30264)

(DE81-024384; DOE/PC-30264/06; QTPR-2) Avail: NTIS HC A03/MF A01

Six baseline tests were made in the Controlled Flash Pyrolysis unit with a coal feed rate of about 2 kg/h. Preliminary material balance and yield data for these tests are presented. A laboratory scale (1 gm/min.) reactor was set up to get once through pyrolysis data. Free radical studies on coal pyrolysis began using an Electron Spin Resonance spectrometer. DOE

N81-33270# Science Applications, Inc., Canoga Park, Calif. Combustion Science and Advanced Technology Dept.

PERFORMANCE MODELING OF ADVANCED GAS BURNER SYSTEMS: CATALOGUE OF EXISTING INTERCHANGE-

ABILITY METHODS Final Report
P. T. Harsha, R. B. Edelman, and D. H. France 1980 132 p refs Sponsored by Gas Research Inst.
(PB81-217622; SAI-80-024-CP; GRI-80/0021) Avail: NTIS HC A07/MF A01 CSCL 21B

The catalogue includes worked examples to illustrate the application of each of the approaches. It was assembled both to provide an up to date compilation of interchangeability methods and to provide the foundation for the establishment of the basic phenomena involved in both interchangeability and fuel effects on gas utilization in general. GRA

N81-33308*# National Aeronautics and Space Administration. Pasadena Office, Calif.
PRESSURE LETDOWN METHOD AND DEVICE FOR COAL CONVERSION SYSTEMS Patent Application
James M. Kendall, Sr. (JPL, California Inst. of Technology Pasadena) and John V. Walsh, inventors (to NASA) (JPL, California Inst. of Technology, Pasadena) Filed 30 Apr. 1981 18 p
(Contract NAS7-100)
(NASA-Case-NPO-15100-1; US-Patent-Appl-SN-259211) Avail: NTIS HC A02/MF A01 CSCL 21D

A pressure letdown device for a pressure dissipating system for a coal gasification reactor is described. The letdown device accepts a polyphase fluid at an entrance pressure and entrance velocity and discharges the fluid from the device at a discharge pressure substantially equal to the entrance temperature and entrance velocity. The device consists of a series of pressure letdown stages including a plurality of coaxially nested symmetrical baffles. The number of apertures or ports for each baffle plate is unique with respect to the number of apertures in each of the other baffles. The mass rate of flow for each port is a function of the area of the port, the pressure of the fluid as applied to the port, and a common pressure ratio established across the ports. NASA

N81-33309# United Technologies Corp., South Windsor, Conn. Power Systems Div.
CHARACTERIZATION OF THE PERFORMANCE OF ADIABATIC REFORMERS OPERATED WITH LOGISTIC FUELS Final Technical Report
J. A. S. Bett, R. R. Lesieur, A. P. Meyer, and H. J. Setzer 30 Jul. 1981 35 p ref
(Contract DAAK70-80-C-0115)
(AD-A103622; PSD/UTC-FCR-3404) Avail: NTIS HC A03/MF A01 CSCL 18/9

United Technologies Corporation, in cooperation with the Electric Power Research Institute, has developed an adiabatic steam reformer capable of processing sulfur-containing fuels for commercial fuel cell power plants. No. 2 fuel oil and various coal-derived liquids have recently been successfully reformed to hydrogen using advanced catalyst formulations. The objective of this program is to determine the performance of the adiabatic reformer when operated with military logistic fuels. The test data will form the basis for system evaluation of the use of the adiabatic reformer in Army 'SLEEP' power plants using military logistic fuels. A two-inch diameter adiabatic reformer capable of supplying the hydrogen required for a 2.5 kW to 6 kW power plant was loaded with advanced metal oxide and nickel catalysts. It ran over 1400 hours; 840 hours with No. 2 fuel oil as reference fuel, 350 hours on unleaded gasoline, and 216 hours on diesel fuel. The performance of the reformer on No. 2 fuel oil (for calibration against previous tests) closely matched previous tests both with respect to fuel conversion and carbon formation characteristics. After an initial decay period of about 200 hours, the performance remained stable for the remaining 1200 hours of test. The reformer operated at conditions set as design goals for a commercial fuel cell power plant. With unleaded gasoline, the tendency for carbon formation was greatly reduced; even at the lowest values for oxygen to carbon ratio in the process steam no carbon was detected. Operating parameters were defined for each of the fuels. The effect of steam/carbon ratio, pressure and fuel flow rate on fuel conversion was determined. GRA

N81-33312# Utah Univ., Salt Lake City. Dept. of Mining and Fuels Engineering.
CHEMISTRY AND CATALYSIS OF COAL LIQUEFACTION, CATALYTIC AND THERMAL UPGRADING OF COAL LIQUID, AND HYDROGENATING OF CO TO PRODUCE FUELS Quarterly Progress Report, Jan. - Mar. 1981
Wendell H. Wiser Jun. 1981 56 p refs
(Contract DE-AC22-79ET-14700)
(DOE/ET-14700/6) Avail: NTIS HC A04/MF A01

Topics covered include: (1) coal cluster solubilization; (2) carbon-13 NMR investigation of coal derived liquids (CDL) and coal; (3) catalysis and mechanism of coal liquefaction; (4) fundamental chemistry and mechanism of pyrolsis of bituminous coal; (5) catalytic hydrogenation of CDL and related polycyclic aromatic hydrocarbons; (6) denitrogenation and deoxygenation of CDL and related N- and O- compounds; (7) catalytic cracking of hydrogenated CDL and related hydrogenated compounds; (8) hydropyrolysis (thermal hydrocracking) of CDL; (9) systematic structural-activity study of supported sulfide catalysts for coal liquids upgrading; (10) diffusion of polyaromatic compounds in amorphous catalyst supports; (11) catalyst research and development; and (12) characterization of catalysts and mechanistic studies. DOE

N81-33314# Oklahoma State Univ., Stillwater. School of Chemical Engineering.
CATALYSTS FOR UPGRADING COAL-DERIVED LIQUIDS Quarterly Report, 1 Apr. - 30 Jun. 1981
B. L. Crynes 16 Jul. 1981 21 p ref
(Contract DE-AC22-79ET-14876)
(DE81-028332; DOE/ET-14876/T4) Avail: NTIS HC A02/MF A01

Five catalysts were analyzed for pore size distributions of characterize their properties for selection for future experimentation. Also, several coal liquid feedstocks were obtained and were analyzed in preparation for future studies. Four experimental runs were conducted in the Catalyst Life test Unit using a 30 wt % SRC in process solvent mixture. These runs were conducted using a Shell 324 catalyst (NiO-MoO3) at a temperature of 3990 C and a pressure of 13.9 MP. The purpose of these runs was to obtain conditioned catalysts in order to assess the coking and deactivation response. Hydrodenitrogenation and hydrogenation of the catalysts decayed over the interval of study of these four experimental runs. Experimental time was from 1 up to 160 hours of oil catalyst contact. DOE

N81-33317# Battelle Pacific Northwest Labs., Richland, Wash.
ENHANCEMENT OF METHANE PRODUCTION IN THE ANAEROBIC DIGESTION OF MUNICIPAL SEWAGE SLUDGE
DOE Jun. 1981 151 p refs
(Contract DE-AC01-76CS-20300)
(DE81-027246; DOE/CS-20300/1) Avail: NTIS HC A08/MF A01

The effect of powdered activated carbon and other additives on digester performance was evaluated in this report. The objectives of the project include optimizing the carbon addition process for maximum methane production, identifying anciliary benefits, establishing design criteria for application at full scale facilities, asessing technical and economic feasibility, and estimating the impact of the technology on a nationwide basis. Results indicate that the actual feasibility of carbon addition technique would produce beneficial effects only at those sites where digesters are operating poorly. DOE

N81-33318# Public Service Electric and Gas Co., Newark, N.J.
DEVELOPMENT OF A CASE STUDY FOR THE CINNAMINSON LANDFILL METHANE RECOVERY OPERATION
Gerald W. Schirra, Thomas E. Sharp, and Douglas C. Nielson (Wehran Energy Corp.) Feb. 1981 67 p
(Contract W-31-109-eng-38)
(DE81-029988; ANL/CNSV-TM-73) Avail: NTIS HC A04/MF A01

The development, construction, and operation of a methane recovery plant on the site of a sanitary landfill are described. The project was undertaken in 2 phases. At the end of the 1st phase, 250,000 cu ft/day of gas (heating value of 600 Btu cu ft) was being produced by the facility and consumed by a nearby industry. At the end of phase 2, 600,000 cu ft/day was being produced (heating value of 561 Btu/cu ft. DOE

N81-33458# Sandia Labs., Albuquerque, N. Mex.
DESIGN AND USE OF DENSITY GAUGES FOR FOSSIL-ENERGY PROCESSES
D. G. Sample, M. G. Thomas, and J. K. Linn Jun. 1981 24 p

refs Presented at the Symp. on Instrumentation and Control for Fossil Energy Processes, San Francisco, 8 Jun. 1981
(Contract DE-AC04-76DP-00789)
(DE81-023306; SAND-81-1347C; CONF-810607-6) Avail: NTIS HC A02/MF A01

A density gauge has been designed to function as a catalyst level detector in the H-Coal 1 inch bench reactor. The system utilizes a Cs137 source and a BiGe scintillator as a detector. The source/detector systems are encompassed in a yoke which can be maneuvered over approximately 1/3 of the reactor height. Both catalyst level and bed uniformity can be measured. The system, as tested, can distinguish coal slurry and roughly 5% catalyst by volume. DOE

N81-33586# Stanford Univ., Calif. Petroleum Research Inst.
NUMERICAL MODELING OF THERMAL RECOVERY PROCESSES SUPRI-TR-12
M. Soliman, W. E. Brigham, and R. Raghaven Jun. 1981 130 p refs
(Contracts DE-AC03-76ET-12056; E(04-3)-1265)
(DE81-025642; DOE/ET-12056/12) Avail: NTIS HC A07/MF A01

Forward combustion in a simulated laboratory combustion tube was investigated. A mathematical model was developed that includes the thermal, thermodynamic, and hydrodynamic aspects of the process. Oil is assumed to burn directly. A fully implicit scheme is used in a simultaneous technique which seems to be much faster than the Gottfried model. The model yields spatial distributions of pressure and temperature and saturations and concentrations of all important components (oil, water, oxygen, inert gas, and steam). Finally, it gives production rates, cumulative production, and instantaneous and cumulative WORs and GORs. The developed model can also simulate other thermal recovery processes, such as hot water flooding and steam injection. DOE

N81-33648# Georgia Inst. of Tech., Atlanta.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 10: SOLAR TECHNOLOGY ASSESSMENT: BIOMASS
Albert P. Sheppard, Jerry L. Birchfield, and Jack M. Spurlock Apr. 1981 59 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.
(Contract DE-FC02-79CS-30478)
(DE81-029011; DOE/CS-30278/T11-Vol-10) Avail: NTIS HC A04/MF 01

The technical status of various biomass fuels, and needed national action and research are summarized. Fuels discussed include biomass liquid fuels from agricultural feedstocks (alcohol), liquid fuels from cellulosic feedstocks, energy from wood, and nonwoody biomass converted to gaseous fuels. DOE

N81-33657# Maurer Engineering, Inc., Houston, Tex.
EVALUATION OF EQUIPMENT AND METHODS TO MAP LOST CIRCULATION ZONES IN GEOTHERMAL WELLS
William J. McDonald, Patrick A. Leon, and Gerard Pittard May 1981 208 p refs Prepared for Sandia National Labs.
(Contract DE-AC04-76DP-00789)
(DE81-769405; SAND-80-7057) Avail: NTIS HC A10/MF A01

Methods to locate, characterize, and quantify lost circulation zones are studied. Twenty-five methods of mapping and quantifying lost circulation zones were evaluated, including electrical, acoustical, mechanical, radioactive, and optical systems. The structured, numerical evaluation plan, used as the basis for comparing the 25 tools, and the resulting among the tools is presented. DOE

N81-33663# Bergbau-Forschung G.m.b.H., Essen (West Germany).
INVESTIGATION OF THE USE OF COAL WASTE AS RAW MATERIAL FOR THE PRODUCTION OF ALUMINUM Final Report
Lother Kuehn, Theodor Schieder, Milan Belsky (Vereinigte Aluminium-Werke AG), Juergen Lotze (Vereinigte Aluminium-Werke AG), and Guenter Winkhaus (Vereinigte Aluminium-Werke AG) Bonn Bundesministerium fuer Forschung und Technologie Nov. 1980 56 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-112; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11.80

Coal wastes, containing on the average 25% Al2O3, represent an important domestic raw material potential for the aluminum industry. Reliable data on the occurrence and composition of wastes from major coal mining areas in the Federal Republic of Germany were collected. The behavior of wastes during extraction with acids was investigated. Possible uses of residual silica are outlined. There exist basic process concepts for the extraction of alumina from the wastes, using experience in the processing of kaolinite. However, transfer to a technical scale requires several years of further development. Author (ESA)

N81-33668# Technical Research Centre of Finland, Helsinki. Fuel and Lubricant Research Lab.
SIMULTANEOUS THERMAL ANALYSIS OF SOLID FUELS
Jussi Ranta and Timo Nyroenen Jul. 1980 87 p refs In FINNISH; ENGLISH summary
(VTT-34; ISBN-951-38-1125-2; ISSN-0355-3590) Avail: NTIS HC A05/MF A01

Different solid fuels, coal, woods, peat grades, and by-products, and organic wastes were studied by thermoanalysis. An atlas for thermal analyses was prepared which compares the different fuel properties. Thermal gravimetry curves derivate thermal gravimetry curves (combustion rate), differential thermal analysis curves, and gas analysis curves. The method enables calculations of ignition temperatures, combustion rates, reaction related temperatures, temperatures of evolving gases, reaction rates, action energies, and frequency factors. Author (ESA)

N81-33674# Johns Hopkins Univ., Laurel, Md. Applied Physics Lab.
GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN UNITED STATES. TECHNICAL ASSISTANCE REPORT NO. 6, GEOTHERMAL SPACE HEATING AND CONDITIONING: MCGUIRE AIR FORCE BASE, NEW JERSEY
F. K. Hill and R. vonBriesen 30 Dec. 1980 44 p refs
(Contracts DE-AI01-79ET-27025; EX-76-A-36-1008)
(PB81-212375; JHU/APL/QM-80-190) Avail: NTIS HC A03/MF A01 CSCL 13A

The feasibility of space heating and cooling 200 multifamily on-base housing units using nonreversible heat pumps and ground water from 1000 ft. depth was studied. The 200 housing units are a part of the 1452 main base multifamily housing complex which is heated from a high temperature and pressure water line. The main system will be converted from natural gas to coal in 1984. Relative cost, amortization periods, and fossil fuel projections are compared. GRA

05

ENERGY CONVERSION

Includes photovoltaic, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors and magnetohydrodynamic generators.

A81-40899 # 18:1 pressure ratio axial/centrifugal compressor demonstration program. J. K. Schweitzer (United Technologies Corp., Government Products Div., West Palm Beach, FL) and J. W. Fairbanks (U.S. Department of Energy, Office of Coal Utilization, Washington, DC). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1479.* 11 p. Contract No. DE-AC05-76OR-05035.

The results of a component technology demonstration program to design and test an advanced axial/centrifugal compressor for industrial gas turbine applications are presented. Objectives were to demonstrate 18:1 pressure ratio at 90% polytropic efficiency with 50% fewer parts as compared to current industrial gas turbine compressors. The compressor design approach utilizes low-aspect-ratio/highly loaded axial compressor blading combined with a centrifugal backend stage to achieve the 18:1 design pressure ratio on a single spool in only seven stages. Demonstrated design point performance was 91.5% polytropic efficiency at 14% stall margin and 70 lbm/sec flow. This represents the highest known demonstrated performance in this pressure ratio and flow class. The results are particularly significant in that they were accomplished at axial compressor aerodynamic loading levels approximately 15% above current production engine design practice. (Author)

A81-41028 # Selection of turbine parameters for steam-hydrogen engine schemes (Osobennosti vybora parametrov turbin dvigatelei parovodorodnykh skhem). N. N. Bykov and M. A. Chekalov. *Aviatsionnaia Tekhnika*, no. 1, 1981, p. 13-18. In Russian.

The problem of turbine parameter selection for steam-hydrogen schemes is investigated analytically. It is shown that specific characteristics of such schemes, combined with differences in the physical properties of combustion gases and hydrogen, make parameter selection criteria for steam-hydrogen engines essentially different from those for conventional gas turbines. Some of these differences are examined. V.L.

A81-41080 Thermodynamics of the r...gnetic equilibria of a semi-collisionless plasma. E. Minardi (EURATOM and Max-Planck-Institut für Plasmaphysik, Garching, West Germany). *Journal of Plasma Physics*, vol. 25, June 1981, p. 413-441. 38 refs.

A statistical model of the collisionless or semi-collisionless equilibria of a magnetically confined plasma is presented which allows the calculation of the entropy and of the thermodynamic potentials as functionals of the collective equilibrium quantities. The entropy principle enables the identification of the magnetic equilibria which are preferentially chosen by the plasma. Stability criteria are derived by declaring unstable an equilibrium which admits in its neighbourhood an accessible equilibrium with higher entropy. The requirement of thermodynamic stability imposes considerable restrictions on the magnetic configuration, on the pressure distribution, and on the velocity distribution function. New conditions for magnetic stability are derived and known results reinterpreted. The theory points towards the force-free configurations, in the case of a current carrying plasma subject to certain physical constraints, or towards the minimum-B configurations, in the general case of arbitrary beta, as the most stable states from the thermodynamic point of view. The formalism is applied to identify the most promising lines to be pursued experimentally in order to achieve magnetic stability in a thermonuclear device. (Author)

A81-41083 The bumpy Z-pinch. T. H. Jensen and M. S. Chu (General Atomic Co., San Diego, CA). *Journal of Plasma Physics*, vol. 25, June 1981, p. 459-464.

The 'bumpy Z-pinch' is a magnetic configuration with potential usefulness for fusion reactors. A conceptually simple version of the configuration is axisymmetric. It contains regions of closed and open field lines. In the region of closed field lines, the field line topology is much like that of a tokamak; these regions link the region of open field lines around the axis of symmetry. Assuming that the plasma spontaneously maintains an equilibrium as described by Taylor (1974), it is possible to maintain indefinitely the regions of closed field lines by driving an axial current through the plasma in the region of open field lines. The ratio between the total axial driven current and the total poloidal current in each of the tokamak-like regions can, in principle, be made arbitrarily small, which means that the load impedance can be arbitrarily large. In addition, the configuration has the inherent virtue similar to that of the spheromak that the tokamak-like part of the plasma does not link any material coils. (Author)

A81-41120 Utility-sized Madaras wind plants. D. H. Whitford and J. E. Minardi (Dayton, University, Dayton, OH). *International Journal of Ambient Energy*, vol. 2, Jan. 1981, p. 3-21. 5 refs. Contract No. EY-76-S-01-2554.

An analysis and technological updating were conducted for the Madaras Rotor Power Plant concept, to determine its ability to compete both technically and economically with horizontal axis wind turbine generators currently under development. The Madaras system uses large cylinders rotating vertically atop each regularly spaced flatcar of a train to propel them, by means of Magnus-effect interaction with the wind, along a circular or oval track. Alternators geared to the wheels of each car generate electrical power, which is transmitted to a power station by a trolley system. The study, consisting of electromechanical design, wind tunnel testing, and performance and cost analyses, shows that utility-sized plants greater than 228 MW in capacity and producing 975,000 kWh/year are feasible. Energy costs for such plants are projected to be between 22% lower and 12% higher than horizontal axis turbine plants of comparable output. O.C.

A81-41121 Heat pumps using heat from lakes and the sea. B. L. Davin, J. Nordling, and K. Sandart (Scandiaconsult International AB, Stockholm, Sweden). *International Journal of Ambient Energy*, vol. 2, Jan. 1981, p. 41-45.

A study is presented on heat pump designs and processes in which lake or sea water both enters and leaves the heat exchanger used in the liquid state, so that only sensible (rather than liquid-solid phase transition, or latent) heat is extracted. Among the factors that must be considered in meeting these criteria are: (1) water temperature should not fall below 3 C, in order to avoid icing, and its average temperature should be as high as possible; (2) sufficient quantitites of water should be available at the lowest required temperature level, thereby eliminating the use of the smaller lakes as sources; (3) the corrosion risks of salinity must be weighed against its advantageous depression of the freezing point; and (4) biofouling must be prevented on all heat-transfer surfaces. Detailed performance and economic figure comparisons are given for 100 kW, 1 MW, and 10MW plants. O.C.

A81-41127 # Hydroelectric power from ocean waves. K. Raghavendran (NGEF-AEG Engineering Co., Ltd., Bangalore, India). *Institution of Engineers (India), Journal, Electrical Engineering Division*, vol. 61, Feb. 1981, p. 169-172.

This paper describes a system which converts the variable energy of ocean waves into a steady supply of energy in a conventional form. The system consists of a set of floats and Persian wheels located off-shore and a storage reservoir on the shore. The floats oscillate vertically as the waves pass below them and turn their respective Persian wheels which lift sea water to a height and deliver to the reservoir through an interconnecting pipeline. The head of water in the reservoir operates a hydraulic turbine which in turn works a generator to supply electricity. Due to the recurrent wave action, water is maintained at the optimum level in the reservoir to ensure continuous power supply. (Author)

A81-41250 Rimmed polyblade wind turbine. P. S. Smith and O. J. M. Smith (California, University, Berkeley, CA). *Sunworld*, vol. 5, Mar. 1981, p. 40-47.

An introduction is given to the design, construction and performance of the rimmed polyblade wind turbine (RPWT), a structurally simple wind-driven generator producing electrical power

synchronized with that of utility grids. The structure of the turbine is essentially that of a bicycle wheel, with thin, NASA GA(w)-2 airfoils threaded over the spokes. Only the rim is in compression, yielding a structure stable enough to withstand gale winds. Among the topics discussed are: (1) the generator-driving turbine wheel; (2) the airfoils; (3) the 230-volt, 3-phase induction generator; (4) the weathervaning tail control; (5) control circuitry; (6) power factors compensation; (7) towers and construction methods; (8) performance; (9) efficiency; and (10) range of applications. O.C.

A81-41277 # Unusual structures observed in X-ray emission from laser-irradiated targets. M. J. Herbst, R. R. Whitlock, and F. C. Young (U.S. Navy, Naval Research Laboratory, Washington, DC). *Physical Review Letters*, vol. 47, July 13, 1981, p. 91-94. 15 refs. Research supported by the U.S. Department of Energy and U.S. Navy.

X-ray images of laser-irradiated solid targets show spicular structures in the blowoff plasma. Higher density is inferred in the structures, which seem to follow the fluid flow from the target. An explanation involving localized fast-electron production is offered. (Author)

A81-41280 Electron dynamics associated with stochastic magnetic and ambipolar electric fields. R. W. Harvey, M. G. McCoy, J. Y. Hsu, and A. A. Mirin (General Atomic Co., San Diego; California, University, Livermore, CA). *Physical Review Letters*, vol. 47, July 13, 1981, p. 102-105. 19 refs. Contract No. DE-AT03-76ET-51011.

Molvig et al. (1978) and Wiley and Hinton (1980) have proposed mathematical descriptions of the combined effect of the stochastic magnetic field and ambipolar electric field on the electron distribution function. In the current investigation, a transport operator is derived from the guiding-center kinetic equation, moment equations are obtained, and the equations are computationally solved for the electron distribution. The electron velocity distribution function at various plasma radii is shown in a graph. Another graph shows the streamlines of electron flow and the characteristics of the transport operator. The transport operator is coupled with Fokker-Planck and Ohmic-heating terms to compute the distribution function. The emerging physical characteristics indicate the possible importance of the ambipolar potential and plasma boundary physics in determining overall plasma confinement. G.R.

A81-41374 Subsonic flow in the channel of a diagonal MHD generator. N. P. Isakova and S. A. Medin (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). *(Teplofizika Vysokikh Temperatur*, vol. 18, Nov.-Dec. 1980, p. 1279-1287.) *High Temperature*, vol. 18, no. 6, May 1981, p. 956-962. 9 refs. Translation.

A numerical analysis is presented of the local and integral characteristics of a two-dimensional subsonic flow in a MHD generator channel with diagonally connected electrodes. It is shown that the parameter distribution inhomogeneity is dependent on the electrical loading, and the largest flow deviations occur at the open and short circuits. A comparison is made with a Faraday type channel with regard to the main integral characteristics. Data from the two-dimensional analysis are compared with those from a one-dimensional flow model. K.S.

A81-41528 Radiation damage in titanium alloys. S. M. L. Sastry, J. E. O'Neal (McDonnell Douglas Research Laboratories, St. Louis, MO), and J. W. Davis (McDonnell Douglas Astronautics Co., St. Louis, MO). In: Titanium '80 science and technology; Proceedings of the Fourth International Conference on Titanium, Kyoto, Japan, May 19-22, 1980. Volume 1. Warrendale, PA, Metallurgical Society of AIME, 1980, p. 651-662. 24 refs. Contract No. EG-77-C-02-4247.

Titanium alloys are among materials being considered for the first wall and blanket structure of a fusion reactor. A description is presented of the crystallographic features of the neutron-radiation-induced defect structure, radiation-induced precipitation of nonequilibrium phases, and annealing of damage microstructure determined by transmission electron microscopic examination of variously heat-treated alpha-beta, alpha, and beta-titanium alloys irradiated to a fluence of 3 x 10 to the 21st neutrons/sq cm. It was found that high-energy neutron irradiation of Ti-6Al-4V results in extensive defect clusters, prismatic loops along with fine, ellipsoidal, 10-20 nm beta precipitates. The beta precipitates redissolve upon annealing the irradiated alloy at 650 C. The causes of beta precipitation were identified to be radiation-enhanced diffusion and radiation-induced segregation of the undersized beta stabilizing element, vanadium, to the defect clusters. G.R.

A81-41728 Vehicle testing of Cummins turbocompound diesel engine. M. C. Brands, J. R. Werner, J. L. Hoehne (Cummins Engine Co., Inc., Columbus, IN), and S. Kramer (U.S. Department of Energy, Washington, DC). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810073.* 23 p.

The performance characteristics and fuel consumption of two turbocompound diesel engines designed for heavy-duty vehicles (Class VIII) are investigated. Results of fuel consumption testing for one engine showed a 14.8% improvement as compared to data of a production NTC-400, used as a baseline. The second engine accumulated 50,000 miles on a cross-country route without malfunction, and tank mileage revealed a 15.92% improvement over the production NTC-400, which was operating on the same route. It is concluded that the turbocompound engine provides increased thermal efficiency, reduced exhaust emissions, lowered noise levels, and improved driveability, while maintaining present standards of durability. An advanced turbocompound engine with further improved fuel economy will be ready for vehicle testing in 1982. E.B.

A81-41729 The automotive Stirling engine - Prime mover for a nonresidential heat pump. B. Goldwater (Mechanical Technology, Inc., Latham, NY). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810087.* 12 p.

The concept of an automotive Stirling Engine Derivative Heat Pump (ASEDHP) product is analyzed from a technological and economical point of view. The status of the Stirling engine technical progress, problem areas and development activities is presented with emphasis on the work needed to ensure heat pump success. The system is described in detail and a performance estimate is given. The critical factors influencing the possible market penetration are discussed, and the analysis shows that a large potential market in excess of 900,000 installed tons per year of refrigeration is estimated. E.B.

A81-41730 Variable stroke power control for Stirling engines. B. Ziph and R. J. Meijer (Stirling Technology, Inc., Ann Arbor, MI). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810088.* 10 p.

A simple method is described for implementing variable stroke power control for Stirling engines by using a variable swashplate activated by a hydraulic stroke converter. It is shown that the high part-load efficiency achieved endows the engine with the capability of developing high torque at low speed without the need for a torque converter and complicated transmissions, while the operating efficiency at high speed is maintained. The hardware making up the system and the operating principles are described in detail. E.B.

A81-41731 The power control system for the Ford-Philips Stirling engine. J. E. Fenton and D. Kosacheff (Ford Motor Co., Dearborn, MI). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810089.* 10 p. 9 refs.

A reliable power control system was developed for the Stirling engine. This control system provides a stable engine speed and an engine speed-accelerator pedal position relationship similar to a spark ignition engine allowing a driver to operate a Stirling-powered vehicle in a conventional manner. (Author)

A81-41733 * Heat engine requirements for advanced solar thermal power systems. L. D. Jaffe and H. Q. Pham (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Society of Automotive Engineers, International Congress and Exposition, Detroit, MI, Feb. 23-27, 1981, Paper 810454.* 10 p. Research supported by the U.S. Department of Energy and NASA.

Requirements and constraints are established for power conversion subsystems, including heat engine, alternator and auxiliaries, of

dish concentrator solar thermal power systems. In order to be competitive with conventional power systems, it is argued that the heat engine should be of less than 40 kW rated output, in a subsystem with an efficiency of at least 40% at rated output and at least 37% at half power. An interval between major overhauls of 50,000 hours is also desirable, along with minor maintenance and lubrication not more than four times a year requiring no more than one man-hour each time, and optimal reliability. Also found to be important are the capability for hybrid operation using heat from a solar receiver, fuel-fired combustor or both simultaneously, operation at any attitude, stability to transients in input power and output loading, operation at ambient temperatures from -30 to 50 C, and compatibility with environmental and safety requirements. Cost targets include a price of $180/kWe, and operation, maintenance and replacement costs averaging $0.001/kWh for 30 years of operation. A.L.W.

A81-41767 # **Computational study of the implosion dynamics on light ion beam fusion.** S. Higaki, S. Ido, K. Imasaki, S. Miyamoto, T. Yabe, K. Nishihara, S. Nakai, and C. Yamanaka (Osaka University, Osaka, Japan). *Osaka University, Technology Reports*, vol. 31, Mar. 1981, p. 73-80. 5 refs.

Light ion beam-driven fusion pellet implosion dynamics were studied by means of one-dimensional hydrodynamic simulation codes. Starting from rough estimates of implosion efficiency in the tamper model, it is shown that beam energy has an optimum value of 10 MeV, yielding implosion efficiency on the order of 0.17. Parameter studies for various power pulses indicate the power shaping that results in the greatest pellet gain. The optimum deuterium fuel density was found to be 28.6 mg/cu cm, where proton beam energy is 50 TW in 40 nsec. O.C.

A81-41855 Generation of high-frequency electrical pulses by means of a shaped-charge explosion. V. M. Titov and G. A. Shvetsov. *(Fizika Goreniia i Vzryva*, vol. 16, Sept.-Oct. 1980, p. 47-56.) *Combustion, Explosion, and Shock Waves*, vol. 16, no. 5, Mar. 1981, p. 522-529. 15 refs. Translation.

Experimental results are presented concerning a pulsed MHD-generator whose operation is based on detonation products formed in the explosion of a cylindrical gas-cumulative charge. Measurements are presented of the velocity, electroconductivity, and efficiency of charge energy conversion into the kinetic energy of the gas-cumulative jet. Magnetic induction in the MHD channel varied from 5 to 25 T; the energy conversion efficiency attained a value of 5%. B.J.

A81-41881 Experimental investigation of the electrical conductivity of a two-phase stream. A. P. Vasil'ev (Orenburgskii Politekhnicheskii Institut, Orenburg, USSR) *(Inzhenerno-Fizicheskii Zhurnal*, vol. 39, Oct. 1980, p. 649-653.) *Journal of Engineering Physics*, vol. 39, no. 4, Apr. 1981, p. 1083-1087. 9 refs. Translation.

The effective electrical conductivity of liquid flow with gas bubbles is described as a function of the volumetric content of the gas phase. Experimental confirmation of the proposed functional relation shows good agreement with measurements at gas content levels below 25%. T.M.

A81-41988 Electrical characteristics of MHD generators with solid electrodes and linear potential distribution on end inserts. G. P. Bazarov, V. A. Bitiurin, E. N. Kufa, and S. A. Medin. *(Magnitnaia Gidrodinamika*, Oct.-Dec. 1980, p. 107-114.) *Magnetohydrodynamics*, vol. 16, no. 4, Apr. 1981, p. 414-419. 9 refs. Translation.

A numerical analysis is used to study the local and integral characteristics of the end sections of Faraday-type MHD generators with solid electrodes and sectioned metallic end strips. The characteristics are investigated in relation to the length of the strips, their position relative to the decreasing magnetic field, and the mode of channel loading for a linear distribution of potential on the strips. It is shown that there exist optimal dimensions of end strips and optimal positions relative to the magnetic field. The characteristics of channels with different end configurations are examined. B.J.

A81-42055 The Darrieus wind turbine for electrical power generation. M. L. Robinson (Department of Defence, Weapons Systems Research Laboratory, Salisbury, Australia). *Aeronautical Journal*, vol. 85, June 1981, p. 244-255. 22 refs.

Aspects of wind as an energy source and the momentum theory of wind turbines are briefly examined. Types of Darrieus wind turbine are described; attention is given to a turbine with airfoil blades curved in troposkein form, and a turbine with straight blades of fixed or variable pitch. The Darrieus vertical-axis wind turbine is then considered with regard to aerodynamics, annual energy output, structures, control systems, and energy storage. Brief reviews of selected Darrieus wind turbine projects are given, including those at Magdalen Islands, Canada, Sandia Laboratories, Reading University, and Australia and New Zealand. P.T.H.

A81-42057 # **Investigation of the effect of the geometry of the electrodes on the characteristics of Faraday-type MHD channels with inhomogeneous flows (Issledovanie vliianiia geometrii elektrodov na kharakteristiki Faradeevskikh MGD-kanalov s neodnorodnymi potokami).** V. K. Tiutin and V. D. Tsar'kov. *Magnitnaia Gidrodinamika*, Apr.-June 1981, p. 97-104. 10 refs. In Russian.

A numerical solution of the two-dimensional problem of the distribution of electric potential and current density in Faraday-type MHD generator channels, with allowance for flow inhomogeneity, is used to study the electrical properties of channels of rectangular and circular cross sections with various electrodes. It is shown that the characteristics of such channels can be improved by the use of rectangular channels with ridge-shaped electrodes, and also by the use of circular channels with circumferentially situated electrodes. The optimal dimensions of such electrodes are determined, and attention is given to the characteristics of MHD channels with ridge-shaped electrodes and modular side walls. F.G.M.

A81-42441 Arrays of three-dimensional wave-energy absorbers. G. P. Thomas and D. V. Evans (Bristol, University, Bristol, England). *Journal of Fluid Mechanics*, vol. 108, July 1981, p. 67-88. 9 refs. Research supported by the Science Research Council.

The behavior of a single linear array of five equally spaced semi-immersed spheres, absorbing energy in a single mode from a regular wave train, is studied both for optimal tuning and for constrained body displacement amplitudes. This is extended to consideration of two parallel rows of such devices. Finally, the spheres are replaced by identical bodies of a particular geometry, containing a strong angular variation, which are studied using a thin-ship approximation. (Author)

A81-42497 # **Tandem-disk theory - With particular reference to vertical axis wind turbines.** J. V. Healey (Belfast, Queen's University, Belfast, Northern Ireland). *Journal of Energy*, vol. 5, July-Aug. 1981, p. 251-254. 7 refs.

The effect of blade shape on the performance of straight-blade turbines is investigated, and an attempt is made to establish the tandem disk system as a model for vertical axis wind turbines. Two unknowns are chosen as independent parameters, and expressions for the windspeeds and power coefficients are obtained in terms of these parameters. Pressure is varied between the two disks, and the power coefficient for the tandem disk model is evaluated. The range of validity of the momentum theory is determined, although with some difficulty, for the single-disk and tandem models. Finally, the theory can be alternatively combined with the blade-element theory, which yields two additional equations, thus resolving the indeterminacy. D.L.G.

A81-42498 # **Comparison of field and wind-tunnel Darrieus wind-turbine data.** R. E. Sheldahl (Sandia Laboratories, Albuquerque, NM). *Journal of Energy*, vol. 5, July-Aug. 1981, p. 254-256. 6 refs. Research supported by the U.S. Department of Energy.

A 2-m-diam Darrieus vertical axis wind turbine with NACA-0012 airfoil blades was tested in the field and in a 4.6 x 6.1-m low speed wind tunnel for a direct comparison. Comparisons were made with field data of equivalent chord Reynolds number, and at equivalent rotational field. Maximum values of the power coefficients compared favorably, and an examination of performance coefficients showed complete agreement between wind tunnel and field data. Due to excellent agreement in the first two comparisons, no further field testing was done, and the accuracy of the wind-tunnel test data was believed verified. D.L.G.

A81-42776 Small turbofan engines - Their impact on general aviation aircraft. L. R. l'Anson and W. F. Schneider (Avco Corp., Avco Lycoming Div., Stratford, CT). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 7-10, 1981, Paper 810622.* 15 p.

The application of small turbofan engines to general aviation aircraft is evaluated with consideration given to the selection of engine cycle parameters, such as fan pressure ratio, bypass ratio and exhaust system. Gas power produced by a gas generator to thrust or flight power for propulsion of a fixed wing aircraft is discussed with emphasis on relating conversion efficiency to specific thrust, bypass and jet velocity ratios, and performance benefits achievable with a mixed exhaust system. The 8.4 bypass ratio fan is found to offer the best fuel economy, with a higher take-off thrust than the low bypass ratio fan, resulting in a 5 percent shorter take-off field length. Fixed flow exhaust improves conversion efficiency and reduces specific fuel consumption by 3 percent. Finally, for cruise speeds above 0.8 Mach number, the power sizing criterion is cruise, providing excess power for OEI climbout, with a resulting increase in propulsion system weight and drag. D.L.G.

A81-42909 Chemical engine using metal hydride. K. Nomura, A. Suzuki, and S. Ono (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2.
Oxford and New York, Pergamon Press, 1981, p. 943-946. 11 refs.

A brief review is presented of a moving picture showing the operation and the process of improvement of the second and the third chemical engine which uses LaNi5 as the energy conversion medium. The high and low temperature heat sources are 75 C and 20 C. The theoretical efficiency is 14.8% in the ideal hydride cycle, and the experimental efficiency is about 6.7%, which is very high for such a low grade heat source. K.S.

A81-43502 # An interpretive overview of the United States Magnetic Fusion Program. J. F. Clarke (U.S. Department of Energy, Office of Energy Research, Washington, DC). *IEEE, Proceedings*, vol. 69, Aug. 1981, p. 869-884.

During the 1950s and 1960s attempts made to control the fusion process were largely unsuccessful. Nonetheless, considerable progress was made during these decades because the science of plasma physics, as it applies to fusion plasmas, was nurtured by the attempts to overcome each experimental difficulty. By the early 1970s, both the science and technology of magnetic fusion had matured to the point that a systematic assault on the fusion problem could be attempted. Critical experimental facilities were constructed during the period from 1973 through 1977. The period since 1977 has represented a period of completion and exploitation of the facilities begun in the previous five years. The scientific and technological results achieved during this period have been sufficiently promising to justify the passage of the Magnetic Fusion Energy Engineering Act of 1980, which sets as national policy a shift from a concentration on scientific feasibility of magnetic fusion to the demonstration of engineering feasibility and the construction of a fusion demonstration power plant by the end of the century. G.R.

A81-43672 * Design and fabrication of a composite wind turbine blade. R. A. Brown (Boeing Engineering and Construction, Seattle, WA) and R. G. Haley (Boeing Aerospace Co., Seattle, WA). In: Materials 1980; Proceedings of the Twelfth National Technical Conference, Seattle, WA, October 7-9, 1980.
Azusa CA, Society for the Advancement of Material and Process Engineering, 1980, p. 1095-1103. Contract No. NAS3-20058.

The design considerations are described which led to the combination of materials used for the MOD-I wind turbine generator rotor and to the fabrication processes which were required to accomplish it. It is noted that the design problem was to create a rotor for a 2500 kW wind turbine generator. The rotor was to consist of two blades, each with a length of 97.5 feet and a weight of less than 21,000 pounds. The spanwise frequency is 1.17-1.45 Hz, and the chordwise frequency 2.80-2.98 Hz. The design life of the blade is 30 years, or 4.35 x 10 to the 8th cycles. The structures of the spars and trailing edges are described, and the adhesive bonding system is discussed. C.R.

A81-43779 Magnetic field due to helical currents on a torus. W. N.-C. Sy (Australian National University, Canberra, Australia). *Journal of Physics A - Mathematical and General*, vol. 14, Aug. 1981, p. 2095-2112. 20 refs.

By means of coordinate transformations on different forms of the Biot-Savart law, general expressions are derived for both the magnetic vector potential and the magnetic field in two systems of toroidal coordinates. For the cases of interest, it is shown that the integrations can be performed exactly in proper toroidal coordinates, whereas approximations are necessary in quasi-toroidal coordinates. Different forms of helical windings are discussed. The results are applied to the calculation of a stellarator magnetic field of arbitrary polarity l, produced by a distribution of helical current filaments on a torus. The components of the magnetic field are given in terms of infinite series. In the intermediate region, away from the external separatrices and the central region, simple analytic expressions for the magnetic surfaces are obtained. (Author)

A81-43805 Explanation of the expulsion of impurities from tokamak plasmas by neutral-beam injection. K. H. Burrell, T. Ohkawa, and S. K. Wong (General Atomic Co., San Diego, CA). *Physical Review Letters*, vol. 47, Aug. 1981, p. 511-515. 23 refs. Contract No. DE-AT03-76ET-51011.

Neutral-hydrogen-beam injection parallel to the plasma current (co-injection) has been observed to produce smaller concentrations of both naturally occurring and injected impurities than counter-injection. We explain this result by considering the effect of plasma rotation on radial impurity transport. This rotation effect could be the basis of an impurity-control technique for tokamak fusion reactors. (Author)

A81-43807 Use of radiative line broadening by an intense laser field as a plasma diagnostic. L. Schlessinger (R & D Associates, Marina del Rey; Pacific Sierra Research Corp., Santa Monica, CA) and J. Wright (R & D Associates, Marina del Rey, CA; Illinois, University, Urbana, IL). *Physical Review Letters*, vol. 47, Aug. 1981, p. 519-522. 6 refs. Contract No. W-7405-eng-48.

In laser-fusion applications the laser electric field can reach large values near the critical surface. We propose a method of determining the strength of these electric fields experimentally. The idea is to use the fact that an intense laser field splits bound-bound radiative transition lines into a band of lines, the width of the band depending on the laser intensity. By seeding a target locally with a low-Z material it should be possible to obtain information on the strength of the laser electric field at different positions in the plasma. (Author)

A81-43820 Ocean wave energy conversion. M. E. McCormick (U.S. Naval Academy, Annapolis, MD). New York, Wiley-Interscience, 1981. 255 p. 288 refs. $40.

The book provides a review of ocean wave mechanics and an introduction to wave energy conversion. Physical and mathematical descriptions are given of the nine generic wave energy conversion techniques along with their uses and performance characteristics. A number of electro-mechanical energy conversion techniques are described. Attention is also given to the possible environmental effects associated with wave energy conversion. C.R.

A81-44050 Measurement of MHD combustion-gas temperatures and potassium number densities in the presence of cold boundary layers. K. Onda, Y. Kaga, and K. Kato (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan). *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 26, Aug. 1981, p. 147-156. 11 refs. Research supported by the Ministry of International Trade and Industry.

A81-44532 Variational moment solutions to the Grad-Shafranov equation. L. L. Lao, S. P. Hirshman, and R. M. Wieland (Oak Ridge National Laboratory, Oak Ridge, TN). *Physics of Fluids*, vol. 24, Aug. 1981, p. 1431-1441. 9 refs. Contract No. W-7405-eng-26.

A variational method is developed for approximate solutions to the Grad-Shafranov equation, in which the surfaces of the constant poloidal magnetic flux are obtained by solving a few ordinary differential equations (which are moments of the Grad-Shafranov

equation) for the Fourier amplitudes of the inverse mapping. The analytic properties and solutions of the moment equations are considered. Specific calculations using the Impurity Study Experiment and Engineering Test Facility/International Tokamak Reactor geometries are performed numerically, and found to agree with standard two-dimensional equilibrium code calculations. The main advantage of the variational moment method is shown to be its reduction of computational time in accurate two-dimensional equilibria calculations. O.C.

A81-44644 Proton beam-target interaction at pellet fusion power densities. E. Peleg and Z. Zinamon (Cornell University, Ithaca, NY; Weizmann Institute of Science, Rehovot, Israel). *Physics of Fluids*, vol. 24, Aug. 1981, p. 1527-1531. 15 refs. Research supported by the U.S. Department of Energy and U.S. Navy.

A calculation is presented of the interaction of a proton beam at pellet fusion power density with initially solid targets, taking radiative losses and radiation conduction into account at the initial stage of the interaction process when the target is not yet optically thin. To demonstrate the basic physical processes, a step function beam pulse of 1 MV and 100 MA/sq cm is assumed; the distribution of the particle angles of incidence extends from 0 to 37 deg with the normal to the target surface. The targets are initially plane foils of gold and copper at solid densities and thicknesses of 15 and 20 microns, respectively. Plane parallel flow is assumed, so that the one-dimensional hydrodynamic equations of motion are solved. Shock waves are handled by the von Neumann-Richtmyer artificial viscosity method (Nardi et al., 1978). Radiative heat transfer is treated in the conduction approximation. Both energy deposition and conduction calculations are performed between hydrodynamic steps, using the time-splitting technique. It is shown that radiation conduction has the effect of extending the high-temperature region in pellet fusion targets beyond the actual deposition regions. K.S.

A81-44714 Superconductivity and its devices. D. S. Forbes (Chattanooga State Technical Community College, Chattanooga, TN). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981.
Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 439-443. 33 refs.

Among the more important developments that are discussed are cryotrons, superconducting motors and generators, and high-field magnets. Cryotrons will create faster and more economical computer systems. Superconducting motors and generators will cost much less to build than conventional electric generators and cut fuel consumption. Moreover, high-field magnets are being used to confine plasma in connection with nuclear fusion. Superconductors have a vital role to play in all of these developments. Most importantly, though, are the magnetic properties of superconductivity. Superconducting magnets are an integral part of nuclear fusion. In addition, high-field magnets are necessary in the use of accelerators, which are needed to study the interactions between elementary particles. (Author)

A81-45167 # Generalized equations for the energetic parameters of a thermoelectric cooler with heat exchange at a section of the longitudinal thermoelectric arm surface (Obobshchennye uravneniia energeticheskikh parametrov termoelektricheskogo okhladitelia s teploobmenom na chasti bokovoi poverkhnosti vetvei). A. I. Griadunov, N. B. Giul'mamedov, and R. Kh. Nadzhafov (Akademiia Nauk Azerbaidzhanskoi SSR, Institut Fiziki, Baku, Azerbaidzhan SSR). *Geliotekhnika*, no. 3, 1981, p. 25-30. In Russian.

A set of equations is derived for the thermal capacity of a thermoelectric converter with heat exchange along a section of the longitudinal surface of the thermoelectric arm. From a consideration of the heat balance equations on the working surfaces of the converter for cases of adiabatically insulated arms and heat transfer along portions of the longitudinal surfaces of the arms, expressions are obtained for the dimensionless cooling and heating capacities of the device as a function of the dimensionless feed current. The equations may be used for the optimization of thermoelectric converter parameters. A.L.W.

A81-45449 A new generation of windmills devised for developing countries (Une nouvelle génération d'éoliennes conçues pour les pays en développement). M. Bremont and J. P. Requier (Institut Universitaire de Technologie, Dakar, Senegal). *Entropie*, vol. 17, no. 97, 1981, p. 201-214. 11 refs. In French.

Four generations of windmills have been developed with the objective of maximum operation reliability for the developing Sahel area. Major applications include water pumping from rivers or canals, grain grinding, refrigeration, and production of electricity. Major types of wind collectors (horizontal-axis slow and rapid collectors, and vertical axis slow and rapid collectors) are reviewed. Optimization is discussed in terms of electronic or electromechanical adaptation between generators and the different collectors. Windmills, with multiple applications in mind, have been built in Senegal and have been used in the Sahel area. It is concluded that such windmills can easily be built in any developing country. K.S.

A81-45450 French work on ocean thermal energy conversion (Travaux français sur l'énergie thermique des mers). P. Marchand (Centre National pour l'Exploitation des Océans, Paris, France). *Entropie*, vol. 17, no. 97, 1981, p. 215-223. 12 refs. In French.

The ocean is discussed as a world-wide potential source of renewable energy, with special attention given to the 'deposit' of ocean thermal energy, which is determined by the temperature difference existing between surface water and that at a depth of 1000 m. A brief history of work done in France is presented, and mention is made of the work of d'Arsonval (1881), Claude and Boucherot (1926), and of projects, such as those at Abidjan and Guadeloupe. Attention is given to the French ocean thermal energy sites, to the Empain-Schneider closed-cycle studies, and the open-cycle floating ocean thermal energy station, with a discussion of thermodynamic considerations and cold water pipes. Problems and prospects are reviewed. K.S.

A81-45451 Geothermal energy and the production of electricity (Géothermie et production d'électricité). J. Varet (Bureau de Recherches Géologiques et Minières, Orléans, France). *Entropie*, vol. 17, no. 97, 1981, p. 224-233. In French.

Geothermal production of electricity, about 2,500 MW throughout the world, is considered. The types of geothermal resources are reviewed. A geothermal field can be used for the production of electricity only if the layer, a porous and permeable stock located at depths of 500 and 1500 m, is carried by a magmatic source at high temperatures. Prospecting and development of high energy geothermal energy are discussed, including feasibility studies and the construction of electric power stations. Once the existence of a field is determined, exploitation can begin, consisting of drilling, steam collecting and purifying, and the construction of turboalternator power plants. An example, the Bouillante-Guadeloupe geothermal power station, is presented. Production sites across the globe are reviewed, and electrical energy costs are discussed. K.S.

A81-45907 Power output of segmented MHD Faraday generators with Hall voltage compensation. D. T. Trung and H. K. Messerle (Sydney, University, Sydney, Australia). *Energy Conversion and Management*, vol. 21, no. 2, 1981, p. 97-103. 5 refs.

Compensation methods are considered for the performance deterioration of a segmented MHD Faraday generator due to Hall voltage effects. Current flow through the generator, and the effect of compensating voltages, are analyzed by means of a simple network analogue. Practical segmentation ratios are found to be less than 0.2, a limit which is shown to be well below that required for the minimization of Hall effects due to electrode length. It is determined that Hall effect compensation can yield a significant increase in generator power only at the expense of a large recirculation of power and internal losses, calling for a substantial increase in the rating of associated inverter equipment. O.C.

A81-45908 Potential drops inside MHD generators. M. S. Sodha, G. V. R. Raju, and B. Gupta (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 2, 1981, p. 105-114. 11 refs. Research supported by the Council of Scientific and Industrial Research.

A theoretical evaluation is made of the potential drops in various regions of MHD generators, taking ambipolar diffusion, the temperature dependence of mobility and thermal conductivity into account. After deriving an expression for the temperature distribution near the electrodes, potential drop theoretical values are compared with experimental results and found to be in significant

agreement. It is concluded that the inclusion of ambipolar diffusion is necessary in the theoretical calculation of potential drops in MHD generators. A detailed graphic presentation is made of experimental data. O.C.

A81-46242 # **Energy for space applications.** J. P. Mullin. *American Astronautical Society, Goddard Memorial Symposium on International Space Technical Applications, 19th, Arlington, VA, Mar. 26, 27, 1981, Paper 81-083.* 14 p.

The current NASA Space Power Research and Technology Program, which is conducted to advance the technology base to meet the future energy needs of space technology, is reviewed. Major directions of the program in meeting short-term energy needs include the provision of high power levels at low cost for near-earth applications, and very high performance levels for future geosynchronous and planetary missions. Far-term projects are aimed at opportunities with the potential for radical change from currently accepted technologies. Specific technologies under consideration include photovoltaic energy conversion, chemical energy conversion and storage, and thermal-to-electric conversion, as well as power system management and distribution and advanced energetics. A.L.W.

A81-46348 **Fuel Cells. III - Gas-permeable non-porous oxygen electrodes.** M. A. Parrish (Lambson, Ltd., Castleford, Yorks., England). *Materials in Engineering*, vol. 2, June 1981, p. 208-214. 36 refs.

Consideration is given the permeation of oxygen through an essentially homogeneous polymer membrane in a three-stage process comprising: (1) the absorbing and dissolving of the gas by the membrane on that side which is exposed to the higher pressure; (2) the diffusion of the gas through the membrane towards the opposite face; and (3) final desorption of the gas from the opposite face. Attention is given the performance of an experimental fuel cell employing Silastic 2432 methyl silicon rubber, with a variety of catalysts. Detailed performance data are given. It is concluded that the ideal polymer membrane electrode must be extremely oxygen-permeable, electronically conductive, catalytic towards oxygen electroreduction, as well as inexpensive and easily fabricated. O.C.

A81-46397 **Calcium thionyl chloride high-rate reserve cell.** E. Peled, A. Meitav, and M. Brand (Tel Aviv University, Tel Aviv, Israel). *Electrochemical Society, Journal*, vol. 128, Sept. 1981, p. 1936-1938. 9 refs.

The goal is to assess the high-rate capability of a reserve type calcium-Ca(AlCl4) thionyl chloride cell and to demonstrate its excellent safety features. The good discharge performance at a discharge time of 10-15 min, together with the excellent safety features of the cell, is seen as warranting further investigations of this system as a candidate for high-rate multicell reserved and non-reserved battery applications. A test is described proving that it is practically impossible to 'charge' this cell. C.R.

A81-46472 **A photogalvanic cell utilizing the photodissociation of iodine in solution.** K. L. Stevenson and W. F. Erbelding (Indiana University; Purdue University, Fort Wayne, IN). *(ACS, Chemical Institute of Canada, Mexican Chemical Society, Mexican Institute of Chemical Engineering, and Mexican Pharmaceutical Association, Chemical Congress, 2nd, Las Vegas, NV, Aug. 24-29, 1980), Solar Energy*, vol. 27, no. 2, 1981, p. 139-141. 9 refs. Research supported by the U.S. Department of Energy.

A photogalvanic cell by which visible light is converted into electricity through the photodissociation of iodine in aqueous and non-aqueous solution is described. The aqueous system mechanism is theorized to involve the formation of an I2(-) or I radical, which becomes reduced at the transparent, illuminated electrode. The efficiency of the system is found to be very sensitive to (1) formal concentrations of I2, (2) wavelength, and (3) on electrode material; with the highest efficiency, 0.03%, observed in a cell containing an indium-tin oxide electrode at 4047 A, and 9FI2, 3FNaI in acetonitrile. O.C.

A81-46360 **Shrouded wind turbine research in Israel.** O. Igra (Negev, University, Beersheba, Israel). *International Journal of Ambient Energy*, vol. 2, Apr. 1981, p. 85-96. 14 refs.

Experimental results are presented which demonstrate that enclosing a turbine inside a specially designed shroud will increase its power output by a factor of two; with the prospect of augmentation factors as high as four resulting from the use of coaxial annular trailing flaps and boundary layer laminarization techniques such as surface suction. The power-augmenting characteristics of shrouds are due to (1) the inviscid wake-recovery effect, which produces a sub-atmospheric pressure region at the shroud exit plane, and (2) the conversion of kinetic energy to a rise in pressure inside the rear part of the shroud. Preliminary economic studies indicate that the shrouded turbine would have lower specific power costs than conventional turbines in at least two power-rating regimes. O.C.

A81-46785 **Theory of a free-field conduction propulsion unit.** V. I. Khonichev and V. I. Iakovlev. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, Sept.-Oct. 1980, p. 109-118.) *Journal of Applied Mechanics and Technical Physics*, vol. 21, no. 5, Mar. 1981, p. 666-673. 6 refs. Translation.

An analysis was made of the effectiveness of a conducting MHD motor with a free field using a flat plate finite width model. The variational problem of determining the optimal potential distribution on the plate with maximum efficiency was solved. It was shown that the consideration of the end effects determines some of the unknown characteristics of the system. A.T.

A81-46787 **MHD generator of electrical energy working on the gasification products of lignites.** V. A. Derevianko, V. S. Slavin, and V. S. Sokolov. *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, Sept.-Oct. 1980, p. 129-138.) *Journal of Applied Mechanics and Technical Physics*, vol. 21, no. 5, Mar. 1981, p. 682-689. 14 refs. Translation.

An investigation is presented of an MHD generator of electrical energy fueled by gasification products of lignite coals using the T-layer effect which eliminates caustic additives. A quasi-one-dimensional theory of linear MHD processes is constructed on the basis of MHD equations; a design of an industrial generator is discussed. A.T.

A81-46824 # **Thermodynamics of the separation-injection cycle of a liquid-metal MHD converter (Termodinamika separatsionno-inzhektornogo tsikla MGD-preobrazovatelia na zhidkikh metallakh /MGDPZhM/).** V. A. Dzhamardzhashvili and I. T. Alad'ev (Gruzinskii Nauchno-Issledovatel'skii Institut Energetiki and Gidrotekhnicheskikh Sooruzhenii, Georgian SSR). *Akademiia Nauk Gruzinskoi SSR, Soobshcheniia*, vol. 102, May 1981, p. 397-400. 12 refs. In Russian.

A81-47120 **Estimating power from wind.** R. D. Diab (Natal, University, Durban, Republic of South Africa). *South African Journal of Science*, vol. 77, Mar. 1981, p. 126-129. 12 refs.

Estimates of both available and usable power in the wind have been obtained using a number of different techniques. It is suggested that, in an unchanging large-scale synoptic situation, it may be permissible to approximate power in the wind by mean statistics. The study also presents a way of determining usable power in the wind by discrete gust analysis. (Author)

A81-47235 **Energy-conversion systems with organic media (Energieumwandlungsanlagen mit organischen Medien).** D. Wolf, G. Schmidt (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany), and S. Haaf (Linde AG, Cologne, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 94-103. In German.

The considered energy-conversion systems are intended for employment as subsystems of solar power stations of the low-power range. The systems are to convert heat energy into mechanical energy and electrical energy. The operational efficiency of energy-conversion systems for the considered applications is particularly important because of the high investment costs for the solar collectors. This efficiency depends to a large degree on a suitable selection of the operational medium and the design of the thermal engine. It is found that organic media have advantages compared to water for the lower temperature range up to 400 C. These advantages are related to an increase in conversion efficiency, and greater

rotational speed. The latter factor ensures the feasibility of an implementation of the required machine parameter values. Suitable organic compounds for operational temperatures below and above 200 C are listed separately. Attention is also given to the advantages of a use of turbines as heat engines and the design data of an energy conversion system currently operating as subsystem of a solar power station in India. G.R.

A81-47238 Economical aspects for large wind energy converters (Wirtschaftlichkeit grosser Windenergiekonverter). H. Selzer (ERNO Raumfahrttechnik GmbH, Bremen, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 142-148. In German.

The reported analysis concerning the economic feasibility of large wind energy converters (WEC) takes into account studies conducted by Timm (1978) and Jarass (1978), and information obtaied in connection with the development of a 2 MW wind energy converter, called Aeolus. Calculations regarding energy-balance aspects in the case of Aeolus show that the energy needed for the manufacture of the WEC will be produced by the WEC from wind energy within 2 to 3 months. In case of a series production of WEC, electric energy could be produced from wind energy at a price of 0.06 DM/KWh. It is pointed out that approximately 65 man-years are needed to produce one large WEC. G.R.

A81-47247 Aerodynamic rotor design of the GROWIAN large-scale wind energy converter (Aerodynamische Rotorauslegung der grossen Windkraftanlage GROWIAN). G. Huss and R. Pempeintner (M.A.N. - Neue Technologie, Munich, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 406-415. In German.

Aerodynamic rotor design for a wind energy plant is examined with reference to rotor blade geometry, number of rotor blades, design top-speed ratio, nominal rotor speed, hub height, and installed generator rating per rotor cycle. The selection and optimization of these parameters for the GROWIAN large-scale wind energy converter is examined taking representative wind data from the North German coastal area as an example. Particular attention is given to the relationship between the aerodynamic rotor design and the expected annual energy production of the system. B.J.

A81-47248 Differences in the control of wind energy converters in grid and isolated operation (Unterschiede bei der Regelung von Windenergiekonvertern im Netz- und Inselbetrieb). G. Cramer, P. Drews, S. Heier, W. Kleinkauf, and R. Wettlaufer (Kassel, Gesamthochschule, Kassel, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 416-428. In German.

Different requirements imposed on the control system for different modes of operation are examined for horizontal axis converters with adjustable rotor blades. The appropriate control structures are developed, and the dynamic behavior of complete plants is described using digital simulation. B.J.

A81-47249 Development of fast rotors with flapping hinges and geometrical pitch-angle setting in an extremely light construction (Schnellläufer-Entwicklung mit Schlaggelenken und geometrischer Blattverstellung in extremer Leichtbauweise). H.-D. Goslich, J. Valett, and W.-H. Kunstmann (Hans-D. Goslich Ingenieurbüro, Hamburg, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 429-440. In German.

Theoretical studies have led to reductions in the force and weight of flapping hinge rotors for use in wind energy systems. A very simple construction and thus easy to maintain, the hinge geometry makes it possible to operate the rotor in any mode, with excellent cost and weight to power ratio. Maximum power supply is possible at very high wind speeds (theoretically 55 m/s) along with idling under the same conditions. The system design makes it possible to employ very large rotor dimensions. B.J.

A81-47251 Dynamic analysis of vertical axis wind turbine blades. L. F. Jesch and R. T. Crossland (Birmingham, University, Birmingham, England). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 450-457. 11 refs.

The angle of attack, thrust coefficient, and Reynolds number variations for each element of a blade in every rotational position of a vertical axis rotor are analyzed by a computer model, using the finite element technique. The thrust coefficient is shown to have four distinct peaks when plotted against the angular position of the shaft. These values oscillate rapidly between positive maxima and negative minima in a complete cycle. The amplitude and frequency of the thrust variations, caused by changes in aerodynamic lift of the rotating blade, are different for every elemental position and are dependent on operating conditions. J.F.

A81-47252 Vertical axis wind mill models - Design testing and evaluation. K. S. Shishodia, K. L. Kumar, and P. L. Sah (Indian Institute of Technology, New Delhi, India). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 458-467.

Vertical axis windmill model designs are tested in a wind tunnel of dimensions 75 cm x 45 cm. The number of airfoil section blades on the windmill are varied from four to eight, and the orientation angle of the blades to the radial lines is changed from 0 to 90 deg. The models are tested at a subsonic low Mach number at wind speeds of 3.6 and 5.1 m/sec and the measurements are used to determine the optimum number of blades and their orientation for optimum power. Results showed that the eight-bladed windmill is more efficient than the four-bladed model. Moreover, the windmill is shown to provide maximum power at 30 deg. Finally, a table of wind speed distributions for windy coastal and non-coastal locations in India is given. J.F.

A81-47253 Regulation and monitoring systems of vertical-axis wind energy converters (Anmerkungen zum Steuerungs- und Überwachungssystem von Windenergiekonvertern mit vertikaler Achse). H. J. Scholz and K. Simhan (Bremen, Universität, Bremen, West Germany). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 468-479. In German.

The definition of regulation and monitoring systems for vertical-axis wind energy converters is still in the preliminary stage. This necessitates a free programmable regulation and monitoring system capable of a flexible response to failure. The broad principles underlying such systems are discussed with reference to the 2.5-kW wind energy converter at the University of Bremen and the draft design of the 60-kW converter planned by ERNO, Bremen. B.J.

A81-47500 International Conference on MHD Electrical Power Generation, 7th, Massachusetts Institute of Technology, Cambridge, MA, June 16-20, 1980, Proceedings. Volumes 1, 2 & 3. Conference sponsored by the Symposia on the Engineering Aspects of Magnetohydrodynamics, Inc., UNESCO, and IAEA. Edited by A. M. Dawson (MIT, Cambridge, MA) and D. Overlan. Cambridge, MA, Massachusetts Institute of Technology, 1981. Vol. 1, 449 p.; vol. 2, 450 p.; vol. 3. 234 p.

The first volume of this conference on magnetohydrodynamics (MHD) for electrical power generation covers: (1) MHD pilot plants; (2) MHD generator experiments and modeling; (3) the performance of various MHD generator types; (4) MHD channel design considerations; (5) MHD channel materials considerations; (6) MHD system components, heat recovery and emissions; and (7) MHD oxidizers and inverters. The second volume deals with (8) MHD system magnets and combustors; (9) MHD field, flow and chemical processes; (10) MHD fluid dynamics; (11) MHD electrical power plant design; (12) current transfer and diagnostics; and (13) MHD power plant systems considerations. O.C.

A81-47527 Cryogenic processes and equipment in energy systems; Proceedings of the Conference, San Francisco, CA, August 19-21, 1980. Conference sponsored by ASME, AIChE, and International Institute of Refrigeration. Edited by W. M. Toscano, R. C. Longsworth, F. J. Zimmermann, and C. F. Gottzmann. New York,

American Society of Mechanical Engineers, 1980. 199 p. $40.

Among the topics on the application of cryogenic technologies to energy systems covered are (1) cryogenic processes and equipment in synthetic fuel plants, such as the integration of gas purification and separation plants in the Sasol II 'oil from coal' complex, depressuring analysis for cryogenic plant safety, large tonnage oxygen plants, and the turbomachinery limitations of large air separation plants; and (2) cryogenic technology for liquefied natural gas production, storage, transportation and handling, including aspects of cryotank frost heave prevention, computer modeling of massive LNG spills from storage tanks, and minimum-work, multistage cascade refrigeration cycles. Also covered are the applications of cryogenic technology to electrical systems, including large cryopumps for fusion power systems, the characterization of superfluid helium transfer, semiconductor electronics at liquid helium temperature, and MHD superconducting magnets. O.C.

A81-47530 Heat transfer in ocean thermal energy conversion /OTEC/ systems; Proceedings of the Winter Annual Meeting, Chicago, IL, November 16-21, 1980. Meeting sponsored by the American Society of Mechanical Engineers. Edited by W. L. Owens (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). New York, American Society of Mechanical Engineers (Heat Transfer Symposia Series, HTD Volume 12), 1980. 76 p. $16.

Among the topics discussed are: condensation heat transfer on long vertical, axially ridged tubes; tests of the Applied Physics Laboratory of Johns Hopkins University (APL/JHU) folded-tube, Ocean Thermal Energy Conversion (OTEC) heat exchanger; the design of a 1.0-MW OTEC heat exchanger for ocean testing, and convective vaporization and condensation in serrated-fin channels. Also considered are: heat tranfer studies of an improved heat transfer monitor for OTEC; an analysis of the mist lift process for mist flow, open-cycle OTEC; the heat transfer characteristics of working fluids for OTEC; and a comparison of major OTEC power system characteristics. O.C.

A81-47579 # The gust generator at the Institute for Aerodynamics and Gasdynamics of Stuttgart University (Der Böengenerator am Institut für Aerodynamik und Gasdynamik der Universität Stuttgart). G. A. Walter and F. X. Wortmann (Stuttgart, Universität, Stuttgart, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-029*. 21 p. In German.

The gust generator is to be used for the production of reproducible temporal and spatial gusts with variable frequency, amplitude, and spectral distribution. The gusts produced are to be employed in the study of the dynamical characteristics of models of wind turbines. Such studies will make it possible to compare theoretical results, obtained on the basis of a numerical investigation of gust problems, with experimental data. The gust generator represents, therefore, an important tool for verifying the correctness of existing computer programs, theories, and assumptions. The gust generator provides also functional control information concerning different control concepts. The design of the gust generator is discussed, taking into account the test section, the blower, the vanes, and the diffusor. G.R.

A81-47716 Accuracy of the net method of calculating the electrical characteristics of the channel in a MHD generator. A. A. Blitshtein, Iu. P. Gusev, V. I. Pishchikov, and S. I. Pishchikov (Akademiia Nauk SSSR, Institut Vysokikh Temperatur; Moskovskii Energeticheskii Institut, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 19, Jan.-Feb. 1981, p. 158-163.) *High Temperature,* vol. 19, no. 1, July 1981, p. 123-127. 8 refs. Translation.

The integral electrical parameters of the channels in MHD generators are calculated by using electric networks consisting of active and passive components, which translate the MHD channel gasdynamic conditions into electrical-engineering language, where each set of the gasdynamic conditions corresponds to a set of parameters in the net model (Yoshida et al., 1977; Blitshtein et al., 1979). To obtain reliable results for channels with substantial wall inhumogeneity in the plasma parameters, the calculation error is determined by the number and dimensions of the net cells in the transverse direction, and a simplified model is used to estimate the error mughitude. Results are compared with those of a study made on the effects of the longitudinal and transverse scales on the integral characteristics of the channel. It is concluded that the results on the current flow transverse to the channel can be used for the preliminary evaluation of the minimum necessary number of layers along the y-axis and the transverse layer dimensions in calculating the integral electrophysical characteristics of a MHD generator channel. K.S.

A81-47717 Numerical study of unsteady processes in a Faraday MHD generator. G. N. Vinogradova and V. P. Panchenko (Akademiia Nauk USSR, Institut Atomnoi Energii, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 19, Jan.-Feb. 1981, p. 164-171.) *High Temperature,* vol. 19, no. 1, July 1981, p. 127-133. 10 refs. Translation.

A numerical study is presented on the unsteady processes occurring in a Faraday MHD generator with a high power-conversion efficiency. A supersonic MHD generator operating with an equilibrium plasma and designed to convert energy in a system using a thermonuclear reactor is considered, and the steady operating modes are established for cases when an ohmic load is connected, disconnected, or reduced. A magnetic field is assumed to be generated by a suitable profiling of the external magnetic field, and the working medium is modeled by an ideal gas. Partial differential equations are solved numerically by using a central difference predictor-corrector scheme. The study can be applied to problems (e.g., transient times, nominal parameter maximal values and rates of change, methods of regulating the generator and switching it on and off) arising during the design of MHD generators. K.S.

A81-48219 # Magnetohydrodynamic boundary layer on a wedge. B. N. Rao and M. L. Mittal (Indian Institute of Technology, Bombay, India). *ASME, Transactions, Journal of Applied Mechanics,* vol. 48, Sept. 1981, p. 656-659. 8 refs.

The effects of the Hall and ionslip currents on the gas-dynamic boundary layer are investigated in view of the increasing prospects for using the MHD principle in electric power generation. The currents are included in the analysis using the generalized Ohm's law (Sherman and Sutton, 1964), and the resulting two nonlinear coupled equations are solved using a modification in the method suggested by Nachtsheim and Swigert (1965), Dewey and Gross (1967), and Steinhauer (1968). Solutions are presented for the incompressible laminar boundary-layer equations in the absence and the presence of the load parameter, and for the pressure gradient parameter for flow separation. K.S.

A81-48232 Study of the dynamics of a standard wave power plant. G. I. Denisenko, A. S. Tsybenko, and S. A. Lavrikov (Kievskii Politekhnicheskii Institut, Kiev, Ukrainian SSR). *(Problemy Prochnosti,* Jan. 1981, p. 27-31.) *Strength of Materials,* vol. 13, no. 1, Sept. 1981, p. 25-30. 5 refs. Translation.

Waterwave powar plant dynamic processes are examined. Equations of motion are derived for such a system; a computation algorithm is constructed illustrated by an example of utilization of sea wave energy. A.T.

A81-48314 # Engineering approach to the development of geothermal power stations. T. Iwamizu (Kyushu Tokai University, Japan). *Periodica Polytechnica, Mechanical Engineering,* vol. 25, no. 1, 1981, p. 19-46.

Measurements are studied for a hot-water type geothermal discharge, and the well characteristics are defined. These investigations, it is pointed out, formed the basis for an engineering approach to the development of the world's first 50 MW geothermal power station with a double-flash-cycle system. C.R.

A81-48315 # Vertical axis wind turbine designed aerodynamically at Tokai University. Y. Kato, K. Seki, and Y. Shimizu (Tokai University, Tokyo, Japan). *Periodica Polytechnica, Mechanical Engineering,* vol. 25, no. 1, 1981, p. 47-56.

The advantages of the vertical axis wind turbine over conventional propeller-type wind turbines are listed, among them the fact that the turbine is free from the gyroscopic loading accompanied by wind direction tracking. Special attention is given to the straight wing type vertical axis turbine, which is thought to be particularly advantageous. Also discussed are the characteristics of the blade. It is pointed out that each blade has an asymmetric airfoil in cross section

that is specially designed to extract wind energy as efficiently as possible. C.R.

A81-48350 Computational partitioning for real-time simulation using a parallel-sequential computer system. R. M. Johnson (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 293-298. 12 refs. Contract No. ET-78-C-01-3087.

The use of a parallel-sequential computer combination for the real-time simulation of an MHD/steam power plant is discussed. The discussion focuses on the modeling approach, description of the simulation facility, and problem partitioning for real-time simulation. Tradeoffs in modeling accuracy vs computational speed and possible hardware modifications for increasing the system capabilities are examined. V.L.

A81-48354 Computer simulation of cored brick regenerative heat exchangers. T. A. Ameel and H. W. Townes (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 311-315. 7 refs. Contract No. ET-78-C-01-3087.

A computer model has been developed to simulate the thermal response of a cored brick regenerative heat exchanger to be used in magnetohydrodynamic energy conversion processes. The model uses a set of finite-difference equations to simulate the heat exchange core between gas and ceramic; the equations calculate the temperature variation of the gas and ceramic along the axis of the heat exchange. The insulation and steel shell are thermally coupled to the core by a second set of finite-difference equations. The physical properties of the core, insulation, and gas are curvefit as functions of temperature, and the vertical gaps between insulator layers, causing thermal resistance in the heat exchange, are also represented. The time, burner operation, and intermediate cooldown cycles necessary to reach cyclic, steady-state operating conditions from room temperature are determined during the start-up simulation; the response of the insulation to changes in core temperature was studied during the steady-state simulation; the time required to reduce the core and insulation temperature to safe operating levels was determined during the shut-down simulation. It was concluded that at least 16 hours are necessary for the heat exchanger to reach cyclic, steady-state conditions, and that during a power failure, a back-up power source will be needed for at least 27 hours to insure the safety of the facility. J.F.

A81-48355 Dynamic simulation of MHD topping cycles. R. Johnson and D. Bartle (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 316-320. 12 refs.

Combined Cycle MHD (magnetohydrodynamics)/steam power plants show promise of achieving high efficiency in coal energy conversion to electricity. The plants are composed of an MHD topping cycle operating in the combustion gas temperature range of 3000-2000 K and a bottoming cycle consisting of a modified steam power plant in the steam temperature range of 810 - 300 K. This paper describes the model and some results of simulating the dynamic performance of a combustor-nozzle-channel-diffuser (CNCD) MHD topping cycle on a general purpose ditigal computer. (Author)

A81-48405 # Dam-Atoll for concentration and conversion of ocean wave energy. T. P. Higgins and C. P. Sherburne (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). *American Institute of Aeronautics and Astronautics, Marine Systems Conference, 6th, Seattle, WA, Sept. 14-16, 1981, Paper 81-2074.* 5 p.

A simple wave energy conversion device has recently been patented by Lockheed. The Dam-Atoll concept uses passive structure and the principle of wave refraction as the primary elements to convert wave energy into usable energy. Each unit can provide 1 to 2 MW in an area of adequate wave energy resource. Plans have been formulated for additional development work which could provide operational systems in the latter part of this decade. (Author)

A81-48525 Control policies for wind-energy conversion systems. I. K. Buehring (Exeter, University, Exeter, Devon, England) and L. L. Freris (Imperial College of Science and Technology, London, England). *IEE Proceedings, Part C - Generation, Transmission and Distribution*, vol. 128, pt. C, no. 5, Sept. 1981, p. 253-261. 11 refs. Research supported by the Science Research Council of England.

Wind energy is usually converted into electrical energy through a wind rotor driving a generator. It is well known that maximum conversion efficiency occurs when the wind rotor is loaded in such a way that its rotational speed is allowed to fluctuate in sympathy with wind-speed variations. In the paper, the wind-rotor/generator dynamics are investigated for a number of control policies, and it is shown that the system response is a function of wind speed. Owing to this relationship, control strategies based on static optimum matching premises are unlikely to be optimal under continuously changing conditions. To prove this hypothesis, the aerogenerator dynamics were simulated on an analogue computer, and, for a given recorded windspeed sample, the energy delivered was measured for a number of control strategies. The results indicate that, for the wind sample used and aerogenerator simulated, sophisticated control policies do not necessarily result in maximum energy yield. An attempt is made to interpret this paradox in terms of the system dynamics. (Author)

A81-48939 Intense ion beams. V. M. Bystritskii and A. N. Didenko (Tomskii Politekhnicheskii Institut, Tomsk, USSR). *(Uspekhi Fizicheskikh Nauk*, vol. 132, Sept. 1980, p. 91-122.) *Soviet Physics - Uspekhi*, vol. 23, Sept. 1980, p. 576-593. 125 refs. Translation.

A review is presented of the theory and experimental results on intense ion beam generation. The problems of generating intense ion beams in different reflex systems, the dynamics of charge flux accumulation, and the formation of the anode plasma are reviewed. Attention is given to magnetically insulated diode systems, their fundamental characteristics, and those of the ion beams that they generate. Intense ion beam shaping, neutralization, transport, and focusing are discussed. Applications are given, and include high-power neutron pulses and inertial controlled thermonuclear fusion. It is concluded that the stationary analytical modes that have been studied give good qualitative agreement with experimental data. Individual problems, such as the motion of the electrode plasma in the AC gap and the role of electrons scattered by the anode require further study. K.S.

A81-49394 # Convective and radiative heat transfer in MHD radiant boilers. K. H. Im and R. K. Ahluwalia (Argonne National Laboratory, Argonne, IL). *Journal of Energy*, vol. 5, Sept.-Oct. 1981, p. 308-314. 10 refs.

A combined convection-gas radiation, two-zone flow model is formulated for study of the heat transfer characteristics of MHD radiant boilers. The radiative contributions of carbon dioxide, water vapor, potassium atoms, and slag particles are included in the formulation, and are determined by solving the radiation transport equation using the P1 approximation. The scattering and absorption cross sections of slag particles are calculated from Mie theory. The model is used to analyze the scale-up of heat transfer in radiant boilers with refractory thickness, wall emissivity, and boiler size under conditions of a gas composition and slag particle spectrum typical of coal-fired MHD combustion. A design procedure is suggested for sizing radiant boilers so as to achieve the required heat extraction rate and to provide a flow residence time that is adequate for decomposition of NO(x) to acceptable levels. (Author)

A81-49395 # Heat transfer scaling laws for MHD channels and diffusers. R. K. Ahluwalia and K. H. Im (Argonne National Laboratory, Argonne, IL). *(Symposium on Engineering Aspects of Magnetohydrodynamics, International Conference on Magnetohydrodynamic Electrical Power Generation, 7th, Cambridge, MA, June 16-20, 1980.) Journal of Energy*, vol. 5, Sept.-Oct. 1981, p. 315-320. 7 refs.

A quasi-three-dimensional flow model is used to study the convective and radiative heat transfer characteristics of coal-fired MHD channels and diffusers. The radiative contributions of carbon dioxide, water vapor, potassium atoms, and slag particles are all included in the model. The scale-up of heat transfer with the size of

MHD channels and diffusers is characterized as an aid to extrapolation of experimental heat transfer measurements. The scale-up of radiation with the channel or diffuser size, centerline temperature, wall temperature, boundary layer thickness, gas pressure, and average size and number density of slag particles is investigated. Generalized plots of gas emissivity and absorptivity are provided for use in estimating radiative heat transfer in MHD channels and diffusers. (Author)

A81-49478 * Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Conference sponsored by the U.S. Army, U.S. Air Force, U.S. Navy, NASA, U.S. Department of Energy, and Communications Satellite Corp. Pennington, NJ, Electrochemical Society, Inc., 1981. 290 p. $30.

Fuel systems are considered along with thermal batteries, primary batteries, lithium primary batteries, lithium/sulfur dioxide primary batteries, lithium/oxychloride primary batteries, high temperature secondary batteries, advanced secondary batteries, and nickel secondary batteries. Attention is given to a Ni-Fe battery with gas recombination device and state-of-charge indication, the development of the nickel-iron battery system for electric vehicle propulsion, improved lead-acid batteries, the behavior of the lead-acid batteries used to start the military vehicles at low temperatures, a life cycle energy analysis of the lead-acid battery, and the anodic corrosion of fiber reinforced lead composites for use in lead-acid submarine batteries. A description is presented of the key physical characteristics for predicting Zr powder burn times, the production of zirconium metal powder for rapid rise time thermal battery application, and high rate lithium-iron disulfide batteries. G.R.

A81-49480 Present status of advanced acid fuel cell electrolytes. A. A. Adams and G. W. Walker (U.S. Army, Mobility Equipment Research and Development Command, Fort Belvoir, VA). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 6-9. 12 refs.

In connection with the multitude of different fuels that are projected for a use in fuel cells, fuel cell electrolytes compatible with a broad range of fuels are needed. The overall objectives of recent advanced acid electrolyte programs have been related to an improvement of fuel cell performance and an extension of the range of useable fuels. The desired objectives are to be obtained by replacing phosphoric acid with new acid electrolytes. Most of the investigations have focused on the use of organic 'superacids', i.e., those organic acids which are similar to inorganic acids, having demonstrated high acid strength and high ionic conductivity. The use of organic acids offers a unique opportunity to prepare an acid with the desirable characteristics required for the fuel cell environment. Studies in half-cells were conducted with trifluoromethanesulfonic acid monohydrate, while perfluoroethanedisulfonic acid was employed in investigations with full cells. G.R.

A81-49481 Accelerated testing of fuel cell components in 2 x 2 inch fuel cells. A. J. Coleman, A. A. Adams, J. A. Joebstl, and G. W. Walker (U.S. Army, Mobility Equipment Research and Development Command, Fort Belvoir, VA). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 9-13.

A description is presented of diagnostic procedures which can be used to predict failure modes and assess the effects of these failures on fuel cell performance. Some straightforward diagnostic techniques have been used to evaluate fuel cells assembled with a variety of matrix and electrode combinations. These techniques included accelerated on-off cycling, thermal cycling with H2/CO mixtures, and automatic polarization measurements. Information has been obtained concerning the effects of electrolyte management and catalyst poisoning on performance and lifetime characteristics of 2 x 2 in. single cells. The use of on-off cycling has shown that short-term fuel cell performance is generally unaffected by load changes and cycle sequence in 2 x 2 in. cells when electrolyte management is adequate. Dynamic polarization curves can be used instead of point by point steady-state plots without any loss in accuracy. G.R.

A81-49483 The effect of DEB powder processing on thermal cell performance. R. Szwarc and R. D. Walton (General Electric Co., St. Petersburg, FL). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 26-29. 8 refs.

During the last twenty years, the system Ca/LiCl-KCl-CaCrO4/Fe has provided the basis for thermal batteries designed for military applications. In connection with greater performance demands, investigations are being conducted concerning the effect of catholyte processing on thermal cell performance. The catholyte layer is composed of three components including the depolarizer (D), CaCrO4, the electrolyte (E), LiCl-KCl eutectic, and the binder (B), finely divided SiO2. The catholyte layer or DEB pellets are produced by blending these components, fusing, pulverizing the cake, and hydrostatically pressing the powder into pellets. A description is given of ten powders which were prepared for the reported study. It was found that the procedure used in powder processing affects the capacity, but not its voltage. Increasing the prebake temperature for CaCrO4 from 400 to 600 C resulted in an increase in capacity. G.R.

A81-49484 Review of chloroaluminate systems for thermal battery applications. R. L. Vaughn and L. A. King (USAF, Frank J. Seiler Research Laboratory, Colorado Springs, CO). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 30-33. 20 refs.

The employment of the conventionally used LiCl-KCl electrolyte in production thermal batteries makes it necessary to employ operational temperatures in the range from 400 to 600 C. The use of such high temperatures has some operational advantages, but it causes also a number of problems related to heat stress and insulation requirements. In cases in which moderate current densities can be tolerated, it is possible to use much lower operational temperatures by employing an equimolar NaCl-AlCl3 mixture as electrolyte. Single cell studies made over a temperature range from 175 to 275 C and a current density range from 15 to 150 mA/sq cm showed that LiAl was a suitable anode material, and chlorides of copper(II), iron(III), and molybdenum(V) were suitable cathode materials. Thermal batteries based on chloroaluminate electrolytes were successfully built and tested. Attention is given to the relevant characteristics of chloroaluminate electrolytes, the results of single cell research, and the current status of battery development. G.R.

A81-49485 Performance data for a lithium-silicon/iron disulfide, long-life, primary thermal battery. R. K. Quinn and A. R. Baldwin (Sandia Laboratories, Albuquerque, NM). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 34-39. 8 refs. Contract No. DE-AC04-76DP-00789.

A primary thermal battery based on the Li(Si)/LiCl-KCl/FeS2 system has been developed. The battery, which has a volume of 400 cu cm, provides a current of 0.5 A at a voltage of 28 V for 60 minutes. A description is presented of the effects of various environmental tests on the performance of this battery. In order to simulate possible nuclear ordnance environments, batteries have been subjected to shock, rhythmic and random vibration, and longitudinal and lateral acceleration in the unactivated and activated state. The level and duration of these tests varied, but the performance remained good. The effects of variation in current density from open circuit to 1 A/sq cm, as well as various pulse loads, are examined. Also presented are results of stabilizing the batteries at temperatures in the range from -54 to 70 C as reflected in various performance parameters. G.R.

A81-49486 Accelerated aging of thermally activated batteries which utilize the Li/Si//LiCl-KCl/FeS2 system. J. Q. Searcy and P. A. Neiswander (Sandia Laboratories, Albuquerque, NM). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 39-42.

The thermally activated Li(Si)/LiCl-KCl/FeS2 batteries considered are intended for applications which require high reliability and a shelf life of 25 years. In order to determine the feasibility of achieving these requirements, an accelerated aging study was undertaken. The major objective of this work was to identify deleterious chemical reactions that could affect performance and reliability

during the 25 year shelf life. The approach used was to accelerate the aging of batteries by storage at elevated temperature, and then to examine and analyze materials from some batteries, while discharging others. The results of the study indicate that the reaction of Li(Si) with water outgassed from the various battery parts is deleterious to shelf life. No other deleterious effects were observed. G.R.

A81-49488 Batteries for air launched weapons. A. Attewell and P. Tattershall (Royal Aircraft Establishment, Farnborough, Hants., England). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 53-56.

Certain types of air launched ground attack weapons need a source of electrical energy and this may conveniently be provided by batteries. The requirements which the batteries have to satisfy in connection with such applications are examined, taking into account the particular characteristics of active primary batteries, reserve type primary batteries, thermal batteries, and liquid electrolyte reserve primary batteries. It is found that, if possible, a reserve type battery should be chosen whenever a battery is required to provide electrical power in an air-launched weapon. A thermal battery should be used unless long duration discharges are required, when a liquid electrolyte type is needed. If no means can be provided for activating a reserve system then, and only then, should active primary cells be considered. Several types are available and show promise of a long shelf life, but the performance of these must be examined, in depth, after real-time storage before they can be committed to project use. G.R.

A81-49489 Primary cells - A forecast of performance. H. Hazkany, E. Peled, and B. Raz (Tel Aviv University, Tel Aviv, Israel). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 56-58.

Of the several existing methods of exploratory forecasting the method of trend extrapolation has been chosen. This method is built upon the assumption that excepting technological revolution, technological characteristics develop in an orderly manner and that development trends are predictable. Attention is given to the Leclanché cell, the alkaline cell, the zinc silver oxide cell, the magnesium cell, the mercury cell, zinc-air cells, and Li cells. It is found that safe commercial high rate cells will have an energy density which is 10 to 20 percent lower than the value corresponding to the maximum capability of the technology. Cells with about 500-630 W-hr/kg are expected to penetrate the market at 1990. Low and high temperature performance and shelf life have almost reached the desirable levels and no vast improvement is expected or needed. Power density is expected to grow to the 500-1000 W/kg range (pulses), but safety problems must be resolved before commercialization. G.R.

A81-49490 Materials selection in Li/SO2 cells. H. Taylor and W. Lees (Duracell Laboratory for Physical Science, Burlington, MA). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 104-108. 10 refs. Research supported by the U.S. Department of Energy.

Attention is given to aspects of seal degradation in lithium systems, test methods, glass degradation, problems of tantalum corrosion, and the results of a number of experimental investigations. On the basis of the results of the evaluation study, a number of conclusions are presented. Whereas the hermetically sealed Li/SO2 cells made since 1975 significantly improved product reliability by eliminating SO2 leakage, corrosion of the glass seal components limited the longevity of this product under extremes of storage, typically to three months at 160 F. At this point, corrosion of the Ta positive terminal and/or loss of insulation resistance could occur resulting in decreased cell performance. Significantly improved product reliability has been realized by coating the glass seal with an inert material but even here instances of Ta corrosion can occur. Judicious selection of both the glass and metal components, particularly the positive termination, has overcome both problems without the necessity for any coating. G.R.

A81-49491 High rate discharge studies of Li/SO2 cells. S. Dallek, R. F. Bis, and F. M. Bowers (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 109-112. 8 refs.

Experimental D-size spirally-wound 3V 10 A-hr cells were used in the reported study. The cells were instrumented with four iron-constantan thermocouples. It was found that during a discharge of a thermally insulated cell, the greatest amount of heat builds up in the center of the cell. The heat build-up appears to be purely resistive in nature. Concerning the safe use of these cells, it has been demonstrated that at very high rates of discharge, e.g., 10 A, cells may vent violently and cause a fire. At this high rate of discharge, the internal cell temperature exceeded the melting point of the lithium anode which is in the form of an unsupported strip. Thus, contact of the highly reactive molten lithium with other reactive species in the cell is possible under these conditions and could result in a very exothermic chemical reaction. G.R.

A81-49492 Recent advances in Li/SO2 battery technology. R. E. Ralston (Duracell International, Inc., Lithium Systems Div., North Tarrytown, NY). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 112-115.

The areas of improvement discussed are related to cell closure-hermetic seals, improved glass-to-metal seals, and lithium-limited cell design. Attention is given to the design of a Li/SO2 cell which can safely withstand discharge below zero volts into voltage reversal. The design characteristics of an unbalanced cell, the new lithium-limited or balanced cell, and a high rate unbalanced design are compared in a table for the 'D' size cell. It is concluded that the improvements in cell closure, glass seal stability, and cell balance have resulted in storability, reliability, and abuse resistance characteristics which make the performance of today's Li/SO2 battery without equal among competitive primary batteries. However, the Li/SO2 cell must not be used in applications where extreme electrical or environmental conditions can push the system beyond its recommended limits. G.R.

A81-49502 45 kW-hr zinc-chloride load-leveling battery module - Recent performance improvements. R. D. Clubb, C. J. Warde, and P. Carr (Energy Development Associates, Madison Heights, MI). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 192-194. Research supported by the Energy Development Associates and Electric Power Research Institute.

The paper deals with the modification of a prototype 45 kW-hr zinc-chloride load-leveling battery module to reach the following performance targets: delivered energy of 50 kW-hr and electrochemical energy efficiency of 60%. The modifications included relocation of the sump to reduce heat transfer between the sump and the store, minimization of intercell electrolyte leakage, increasing the thickness of the busing, and rebuilding the gas/hydrate former pump. These modifications increased the delivered energy to a maximum of 53.6 kW-hr; the maximum electrochemical energy efficiency observed in the same series of experiments was 60.3%. V.L.

A81-49850 Resources for electric vehicles and their infrastructure; Proceedings of the Third International Conference, London, England, November, 1979. Conference supported by the European Electric Road Vehicle Association, IEA, Chartered Institute of Transport, et al. Stevenage, Herts., England, Peter Peregrinus, Ltd. (PPL Conference Publication, No. 16), 1980. 157 p. $23.50.

Topics discussed include the planned use of resources for electrical vehicles, the range and recharging infrastructure of transport systems, and future investments and planning. Particular attention is given to the availability of future fuels, the possible effects of economic changes upon future transport systems, and the operational requirements of an integrated transport system utilizing tramways, railways, and the metro. Consideration is also given to the development of a hybrid electric vehicle, the use of fuel cells in vehicles, and the production cost changes arising from a series production of electric vehicles. J.F.

A81-49874 Electric and hybrid vehicle progress; Proceedings of the International Congress and Exposition, Detroit, MI, February 23-27, 1981. Congress and Exposition sponsored by the

Society of Automotive Engineers, Warrendale, PA, Society of Automotive Engineers, Inc. (SAE Proceedings P-91), 1981. 188 p. $30.

The impacts of use-pattern on the design of electric and hybrid vehicles are considered along with a free piston engine-pump for an automotive propulsion system, the new breed of hybrid vehicles, the cost and potential of hybrid vehicles, hybrid vehicle test procedure development, the design studies of continuously variable transmissions for electric vehicles, and electronically commutated dc motors for electric vehicles. Attention is given to the development of a dc motor controller, voltage considerations for electric vehicle propulsion systems, the characterization of the near term electric vehicle (ETV-1) breadboard propulsion system over the SAE J227a Driving Schedule 'D', the zinc-chloride electric engine unit for a four-passenger electric vehicle, and aspects of electric vehicle battery management. A description is presented of performance testing and system evaluation of the DOE ETV-1 electric vehicle, an economical EV data compression system with sensors, the economics of electric vehicles, and the impact of technology development in economics of electric vehicles in fleet operations. Other topics considered are related to the operating experience of electric vehicles in city government fleet operations, EV technology and fleet experience, electric vans in regular commercial service, field test experience with electric vehicles, and the fuel economy potential of heat engine/flywheel hybrid vehicles. G.R.

A81-49896 **Methods of resynchronizing wind turbine generators.** P. C. Krause and O. Wasynczuk (Purdue University, West Lafayette, IN). *(Institute of Electrical and Electronics Engineers, Winter Meeting, Atlanta, GA, Feb. 1-6, 1981, Paper 81-WM-162-7.) IEEE Transactions on Power Apparatus and Systems*, vol. PAS-100, Oct. 1981, p. 4301-4307; Discussion, p. 4308. 12 refs. Contract No. DE-AS02-77ET-29100.

A method is described for resynchronizing wind turbine generators (WTG) which reduces the time for reestablishing normal operation following an electrical disturbance. The WTG studied has a blade speed of 17.55 rpm geared to a four-pole, 2.5 MW synchronous generator; the blades are upwind, horizontal axis propeller type, each 150 ft long with 45 ft of controllable tip length. Load rejection is used as the electrical disturbance. Several methods of reclosing are discussed, and arbitrary reclosing is discouraged. Reclosing when the voltage phase difference between WTG and the network is within prescribed limits is found to be acceptable, despite its requirements for high speed switching equipment with a complex control system. The safest approach is one which involves bringing the hub speed to a constant value and then reverting to the normal pitch control immediately following reclosing. Reclosing the WTG with sufficent damping of the soft shaft mode can be accomplished more smoothly than for a WTG in which the mode is lightly damped. It is also shown that satisfactory reclosing and reloading of a WTG is practical by modifying the proposed pitch control to include hub speed damping in both the high and low modes. J.F.

A81-49897 **Study of technical and economic feasibility of fuel cell cogeneration applications by electric utilities.** W. S. Ku (Public Service Electric and Gas Co., Newark, NJ) and R. A. Wakefield (Mathtech, Inc., Arlington, VA). *(IEEE, ASME, and ASCE, Joint Power Generation Conference, Charlotte, NC, Oct. 7-11, 1979.) IEEE, Transactions on Power Apparatus and Systems*, vol. PAS-100, Oct. 1981, p. 4309-4318.

A previous EPRI study showed significant potential penetrations of fuel cells into the future generation mixes of U.S. electric utilities. A new EPRI-sponsored study was conducted to investigate the possible additional benefits of operating these utility-owned fuel cells as cogeneration facilities. Three classes of applications were evaluated: residential and commercial buildings, industrial processes and utility power plants. Incremental breakeven capital costs between cogenerating and electric-only fuel cells were determined with respect to conventional thermal energy supply alternatives. The results showed that there are sufficient economic incentives for fuel cell cogeneration in all three classes of applications. (Author)

N81-28448# Sandia Labs., Albuquerque, N. Mex.
GUY CABLE DESIGN AND DAMPING FOR VERTICAL AXIS WIND TURBINES
Thomas G. Carne 1981 9 p refs Presented at the 2nd DOE/NASA Wind Turbine Dyn. Workshop, Cleveland, 24 Feb. 1981
(Contract DE-AC04-76DP-00789)
(SAND-80-2689C; CONF-810226-3) Avail: NTIS HC A02/MF A01

Design parameters affecting the support strength and the stiffness of the guy at the top of the turbine are discussed. Limiting the axial load which the guys apply to the tower, bearings, and foundations is an important objective of cable design. The lateral vibrations of the cables is considered. A graph of modal frequencies versus cable stiffness is presented. A technique for damping cable vibrations is mathematically analyzed and demonstrated with experimental data. DOE

N81-28485# Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
ANALYSIS OF STRONG NOCTURNAL SHEARS FOR WIND MACHINE DESIGN Final Report
L. Mahrt and R. C. Heald Nov. 1980 77 p refs
(Contract DE-AT06-79ET-23116)
(DOE/ET-23116/80-1) Avail: NTIS HC A05/MF A01

Wind shear data at wind turbine heights from several sites is reviewed and new data is documented in terms of total and component shear. A variety of atmospheric scenarios may combine to give large persistent shear. Among these, strong boundary layer stability is foremost. It occurs with strong nocturnal surface cooling, in low level frontal and subsidence inversions, and in thunderstorm outflows. Strong shears resulting from surface radiation inversions are evident over the High Plains where dry air and high altitude combine to result in strong radiational cooling. Terrain is also an important influence on shear but it is not well understood and is very site specific. DOE

N81-28516*# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
MOD-0A 200 kW WIND TURBINE GENERATOR DESIGN AND ANALYSIS REPORT Final Report
T. S. Anderson, C. A. Bodenschatz, A. G. Eggers, P. S. Hughes, R. F. Lampe, M. H. Lipner, and J. R. Schornhorst Aug. 1980 394 p refs
(Contracts DE-AB29-76ET-20370; DEN3-163)
(NASA-CR-165128; DOE/NASA/0163-2; AESD-TME-3052) Avail: NTIS HC A17/MF A01 CSCL 10B

The design, analysis, and initial performance of the MOD-0A 200 kW wind turbine generator at Clayton, NM is documented. The MOD-0A was designed and built to obtain operation and performance data and experience in utility environments. The project requirements, approach, system description, design requirements, design, analysis, system tests, installation, safety considerations, failure modes and effects analysis, data acquisition, and initial performance for the wind turbine are discussed. The design and analysis of the rotor, drive train, nacelle equipment, yaw drive mechanism and brake, tower, foundation, electrical system, and control systems are presented. The rotor includes the blades, hub, and pitch change mechanism. The drive train includes the low speed shaft, speed increaser, high speed shaft, and rotor brake. The electrical system includes the generator, switchgear, transformer, and utility connection. The control systems are the blade pitch, yaw, and generator control, and the safety system. Manual, automatic, and remote control are discussed. Systems analyses on dynamic loads and fatigue are presented. J.M.S.

N81-28519*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PUMPING POWER CONSIDERATIONS IN THE DESIGN OF NASA-REDOX FLOW CELLS Final Report
Mark A. Hoberecht Jun. 1981 12 p refs
(Contract DE-AI04-80AL-12726)
(NASA-TM-82598; DOE/NASA/12726-7) Avail: NTIS HC A02/MF A01 CSCL 10C

Pressure drop data for six different cell geometries of various flow port, manifold, and cavity dimensions are presented. The redox/energy/storage system uses two fully soluble redox couples as anode and cathode fluids. Both fluids are pumped through a redox cell, or stack of cells, where the electrochemical reactions take place at porous carbon felt electrodes. Pressure drop losses are therefore associated with this system due to the continuous flow of reactant solutions. The exact pressure drop within a redox flow cell is directly dependent on the flow rate as well as the various cell dimensions. Pumping power requirements for a specific set of cell operating conditions are found for various cell geometries once the flow rate and pressure drop are

determined. These pumping power requirements contribute to the overall system parasitic energy losses which must be minimized, the choice of cell geometry becomes critical. E.D.K.

N81-28643# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
THIN FILM BATTERY/FUEL CELL POWER GENERATING SYSTEM Final Report, 1 Apr. 1978 - 31 Mar. 1980
W. Feduska, A. O. Isenberg, J. E. Bauerle, E. F. Federmann, Y. Ishikawa, R. J. Ruka, E. J. Vidt, S. A. Zeitman, and G. E. Zymboly 30 Jun. 1980 216 p refs
(Contract DE-AC03-79ET-11305)
(DOE/ET-11305/T7; C-1197-17) Avail: NTIS HC A10/MF A01

Research on the design, development, and testing of a high temperature solid electrolyte (HTSOE) fuel cell is described. Development and refinement of fabrication processes for the porous support tube, fuel electrode, solid electrolyte, air electrode, and interconnection are included. Life testing was conducted of cell components and the stack. Stack performance was evaluated. DOE

N81-28644# Galaxy, Inc., Washington, D.C.
JAPANESE RESEARCH AND DEVELOPMENT OF FUEL CELLS
Feb. 1981 28 p
(Contract DE-AC03-79SF-10538)
(DOE/SF-10538/T6) Avail: NTIS HC A03/MF A01

An overview of the Japanese fuel cell program is presented including an historical background of Japanese research and development of fuel cells, the research and development in the Moonlight Project, and a description of the current status of activities of private companies which expect to purchase fuel cells. DOE

N81-28655# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
BASELINE DESIGNS OF MOORED AND GRAZING 40-MW OTEC PILOT PLANTS. VOLUME A: DETAILED REPORT
J. F. George and D. Richards Jun. 1980 270 p refs Prepared jointly with ABAM Engineers, Tacoma and Glosten (L. R.) and Associates, Inc., Seattle 2 Vol.
(Contracts DE-AI01-77ET-20343; N00024-78-C-5384)
(JHU/APL-SR-80-1-Vol-A) Avail: NTIS HC A12/MF A01

Baseline designs of two types of floating Ocean Thermal Energy Conversion (OTEC) pilot plants are presented. Both designs feature floating concrete hull structures that house up to 40 MW sub e (net) of OTEC power systems. One plant is designed for moored operation at an island site, and use underwater cables to transmit electric power to a shore-based utility company. The other plant is self-propelled and cruises slowly through tropical waters, using the OTEC electric power to produce an energy intensive product onboard, where it is stored for later transshipment to market. DOE

N81-28656# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
BASELINE DESIGNS OF MOORED AND GRAZING 40-MW OTEC PILOT PLANTS. VOLUME B: ENGINEERING DRAWINGS
Jun. 1980 270 p Prepared jointly with ABAM Engineers, Tacoma and Glosten (L. R.) and Associates, Inc., Seattle 2 Vol.
(Contracts DE-AI01-77ET-20342; N00024-78-C-5384)
(JHU/APL-SR-80-Vol-B) Avail: NTIS HC A12/MF A01

Baseline design data are presented for two types of floating Ocean Thermal Energy Conversion (OTEC) pilot plants: (1) a moored plant that uses underwater cables to transmit electric power to a shore-based utility company, and (2) a cruising plantship that uses the OTEC electric power to produce an energy-intensive product onboard, where it is stored for later transshipment to market. Engineering drawings of the hull, cold-water pipe, ship outfitting and machinery, OTEC power system, electrical system, and folded-tube heat exchangers are provided. DOE

N81-28660# Institute of Gas Technology, Chicago, Ill.
STATUS OF MOLTEN CARBONATE FUEL CELL TECHNOLOGY
L. G. Marianowski and John B. OSullivan 1981 16 p refs Presented at the 8th Energy Technol. Conf. and Exposition, Washington, D.C., 9-11 Mar. 1981 Sponsored in part by General Electric Co., DOE, Electric Power Research Inst. and the Gas Research Inst.
(CONF-810315-8) Avail: NTIS HC A02/MF A01

A molten carbonate fuel cell integrated with a coal gasification power plant is one of the most promising coal-using technologies because of its high efficiency acceptable cost, and environmental acceptability. The high temperature heat available from the fuel cell may be used in a bottoming cycle and/or industrial cogeneration applications; however, for the molten carbonate system to achieve these goals, continued developmental work is required which must take account of the operating conditions of the application. The progress made in improving cell performance and life and in producing inexpensive cell components is discussed. The status, direction, and priority of future research and engineering efforts is also discussed. DOE

N81-28598# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
ENERGY RESEARCH. SCIENTIFIC STATUS REPORT Status Report, 1980 [FORSCHUNGSBEREICH ENERGETIK. WISSENSCHAFTLICHER BERICHT - STAND 1980]
Hans Joachim Holtz, ed. 1981 107 p refs In GERMAN Original contains color illustrations
Avail: NTIS HC A06/MF A01

The first work group reports on solar thermal power stations, solar energy resources, tubular collector designs, and heliostat designs, low pressure Cs diodes, cermet emitters, and thermionic converters as well as hydrogen storage and cryoadsorbents are also discussed. Applications of gas dynamic CO lasers, plasma physics, and Lyman transitions of hydrogen atoms are covered. The RIT-10 RF thruster system, thruster components, and the detection of oil breakdown in aircraft engines are touched on as well. Activities of the second group include studies of HF vibrational relaxation in a shock tube, hydrogen production, thermal decomposition of SO2, and flame quenching and exhaust hydrocarbons in a combustion chamber. The energy of diatomic molecules, local temperature measurements in flames, laser Raman spectroscopy, and absolute transition probabilities and particle densities from saturated fluorescence excitation are also dealt with. Investigations of the third group involve analytical mass modeling of chemical rocket stages for space flight, development of chemical propulsion modules and a propulsor platform for low altitude payload delivery. Author (ESA)

N81-28599# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
A PRELIMINARY THEORETICAL STUDY OF DOUBLE BLADE TWO-DIMENSIONAL AERODYNAMICS FOR APPLICATIONS TO VERTICAL AXIS WIND TURBINES Final Report
Erling Welbust 21 Apr. 1981 69 p refs
(Contracts PE-450-01; NE-5061-451)
(FFA-TN-AU-1635) Avail: NTIS HC A04/MF A01

A NASA model for computing the subsonic, viscous, attached flow around multielement airfoils was used to determine the amount of energy lost when using double blades rather than single ones. The resulting tangential force for the double or single blade configuration used as a criterion is found. Radial spacing, toe-in toe-out angle and tangential displacement (stagger) were varied to see how tagential force is affected. The greatest tangential force values are found to be achieved for maximum allowable radial spacing, which is determined by structural considerations, and is assumed to be on the order of 1.5 c. At this rather large distance, stagger as well as toe-in toe-out angle only gives slight improvements as long as the flow separation effects (stall region) are not considered. A large part of the energy is captured at relatively high wind speeds when the flow on the blades is partly separated (stalled). Author (ESA)

N81-28600# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
SAFETY AND WIND ENERGY CONVERSION SYSTEMS WITH HORIZONTAL AXIS (HA WECS)
Sigge Eggwertz, Ingemar Carleson, Anders Gustafsson, Magnus Linde, Christer Lundemo, Bjoern Montgomerie, and Sven-Erik Thor 19 Mar. 1981 170 p refs
(Contract NE-5061)
(FFA-TN-HU-2229) Avail: NTIS HC A08/MF A01

Hazards imposed by a wind energy conversion system on the general public and on the operator personnel by complete collapse, by separation of fractured parts, or by pieces of ice (flying off) were calculated to provide a manual for safety evaluations. Land based large scale turbine systems with horizontal axes situated in areas with sparse population are considered.

Blade material is assumed to be steel, aluminum alloy or fiber reinforced plastics; the tower being built of steel or reinforced concrete. Primary structure, function and failure modes are identified. Statistical information of loads and load combinations, strength properties of materials and geometry deviation are provided. A simplified method of risk analysis is described. The object and function of a safety system, both hardware and software, is reviewed, considering the effects of inspection and repair. The probability of being hit is evaluated, provided a fracture occurs and a risk zone is established. Author (ESA)

N81-28822# California Univ., Livermore. Lawrence Livermore Lab.
PRELIMINARY DESIGN OF A TANDEM-MIRROR-NEXT-STEP FACILITY
C. C. Damm, J. N. Doggett, R. H. Bulmer, W. S. Neef, G. W. Hamilton, A. E. Sherwood, S. Szybalski, S. M. Boghosian, G. A. Carlson, and R. W. Moir 18 Dec. 1980 120 p refs
(UCRL-53060) Avail: NTIS HC A06/MF A01

The Tandem-Mirror-Next-Step (TMNS) facility is designed to demonstrate the engineering feasibility of a tandem-mirror reactor. The facility is based on a deuterium-tritium (D-T) burning, tandem-mirror device with a fusion power output of 245 MW. The fusion power density in the central cell is 2.1 MW/m(3), with a resultant neutron wall loading of 0.5 MW/m(2). Overall machine length is 116 m, and the effective central-cell length is 50.9 m. The magnet system includes end cells with yin-yang magnets to provide magnetohydrodynamic (MHD) stability and thermal-barrier cells to help achieve a plasma Q of 4.7 (where Q = fusion power/injected power). Neutral beams at energies up to 200 keV are used for plasma heating, fueling, and barrier pumping. Electron cyclotron resonant heating at 50 and 100 GHz is used to control the electron temperature in the barriers. Based on the resulting engineering design, the overall cost of the facility is estimated to be just under $1 billion. Unresolved physics issues include central-cell beta-limits against MHD ballooning modes (the assumed reference value of beta exceeds the current theory derived limit), and the removal of thermalized alpha-particles from the plasma. GRA

N81-28988# California Univ., Livermore. Lawrence Livermore Lab.
FLEXIBILITY OF MFTF-B FOR THERMAL-BARRIER MODIFICATIONS AND AXISYMMETRIC UPGRADES
K. I. Thomassen 25 Mar. 1981 25 p refs
(Contract W-7405-eng-48)
(UCID-18948) Avail: NTIS HC A02/MF A01

Flexibility in MFTB-B is achieved partly by using the margins in particle and energy control designed into the machine and partly by making modest changes based on results obtained in TMX Upgrade. This latter flexibility is permitted by the schedule for vessel construction and component fabrication. The changes one might expect were determined by an examination of the processes involved in creating a thermal barrier and by speculating on the range of outcomes from TMX Upgrade experiments. DOE

N81-29040# California Univ., Livermore. Lawrence Livermore Lab.
ADVANCED VEHICLE OF THE DOE ELECTRIC AND HYBRID VEHICLE PROGRAM
Lawrence G. OConnell Dec. 1980 37 p refs Presented at the Elec. and Hybrid Vehicle Advan. Technol. Seminar, Pasadena, Calif., 8 Dec. 1980
(Contract W-7405-eng-48)
(UCRL-86390; CONF-801232-5) Avail: NTIS HC A03/MF A01

The performance requirements for and the technical or economic barriers which must be overcome in the development and production of advanced electric vehicles (EV) or hybrid-electric vehicles are discussed. The technologies compared include EV's using battery exchange, hybrid EV's using batteries and a small heat engine, roadway powered EV's, EV's with aluminum air batteries, and EV's with fuel cells. DOE

N81-29363# InterTechnology Solar Corp., Warrenton, Va.
RESEARCH AND DEVELOPMENT OF THE OSMO-HYDRO POWER HEAT ENGINE Final Report
25 Nov. 1980 212 p refs
(Contract DE-AC05-78ET-15346)
(DOE/ET-15346/T1; ITC/Solar-251180) Avail: NTIS HC A10/MF A01

The osmo-hydro power or pressure-retarded osmosis heat engine is possible means for producing economical electric power from low-temperature heat sources. The engine utilizes semipermeable membranes to cause the permeation of a solvent from a dilute low-pressure solution to a concentrated high-pressure solution. The potential energy thus acquired is converted to useful energy by means of a turbogenerator. The process can be considered as one in which the free energy of mixing is converted to useful power. By appropriate application of a heat source and a heat sink, the original dilute and concentrated solutions are recovered, thus completing the heat engine cycle. DOE

N81-29365# Department of Energy, Washington, D. C. Office of Nuclear Reactor Programs.
US CENTRAL STATION NUCLEAR ELECTRIC GENERATING UNITS: SIGNIFICANT MILESTONES Status Report, 1 Jan. 1981
Mar. 1981 41 p
(DOE/NE-0030/1(81)) Avail: NTIS HC A03/MF A01

Construction and operational milestones are tabulated for U.S. nuclear power plants. Data are presented on nuclear steam supply system orders. A schedule of commercial operation through 1990 is given. DOE

N81-29443# Westinghouse Electric Corp., Concordville, Pa. Combustion Turbine Systems Div.
GAS TURBINE COMBUSTOR PERFORMANCE ON SYNTHETIC FUELS Final Report
S. M. DeCorso, P. W. Pillsbury, G. Bauserman, P. R. Mulik, M. J. Ambrose, and T. R. Stein (Mobil Research and Development Corp.) Jun. 1981 223 p refs Sponsored by EPRI
(EPRI Proj. 989-1)
(EPRI-AP-1623-Vol-2) Avail: NTIS HC A10/MF A01

The effects of burning coal- and shale-derived synthetic liquid fuels in state-of-the-art gas turbine combustors was determined. Ten types of coal-derived liquid fuels from the SRC-I, SRC-II, EDS, and H-Coal processes, and three hydrogenated shale oil fuels were utilized. The main conclusion was that synthetic fuels burned approximately as expected from extrapolation of the combustion results obtained with petroleum fuels. Synthetic fuels with hydrogen content greater than approximately 10% (by weight) and nitrogen content less than approximately 0.35% should be satisfactory for engines of current design. A wider selection of synthetic fuels could be used in engines of a lower pressure ratio and/or turbine inlet temperature. Conversely, designs of higher turbine inlet temperature and/or pressure ratio would require tighter fuel specifications or the development of improved combustor cooling, smoke performance, and NO/sub x/ suppression. Author

N81-29449# General Electric Co., St. Petersburg, Fla. Gas Turbine Div.
DEVELOPMENT OF HIGH-TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO A TECHNOLOGY READINESS STATUS, PHASE 2 Quarterly Report, Jan. - Mar. 1981
M. W. Horner Apr. 1981 80 p
(Contracts DE-AC01-76ET-1034; EX-76-C-01-1806)
(DOE/ET-10340/T4) Avail: NTIS HC A05/MF A01

Progress in developing a technical readiness vehicle (TRV) for demonstrating the performance of a combined-cycle power plant with high-temperature, 2600 to 3000 F firing temperature, gas turbines using coal-derived gas fuel is reported. Work on the combined-cycle power plant and TRV design, component development, aerodynamics studies, simulation, and fuel gas cleanup systems is described. DOE

N81-29450# General Electric Co., St. Petersburg, Fla. Gas Turbine Div.
HIGH-TEMPERATURE TURBINE TECHNOLOGY PROGRAM. TURBINE SUBSYSTEM DESIGN REPORT: LOW-Btu GAS
M. W. Horner Dec. 1980 227 p
(Contracts DE-AC01-76ET-10340; EX-76-C-01-1806)
(DOE/ET-10340/T3) Avail: NTIS HC A11/MF A01

The updated turbine subsystem design for a coal-derived gas fuel (low-Btu) operation at 2600 F turbine firing temperature is described. A commercial integrated gasification combined cycle (IGCC) plant configuration would contain four gas turbines. These gas turbines utilize an existing axial flow compressor from the GE product line MS6001 machine. Trends in overall plant

performance improvement at higher pressure ratio and higher firing temperature are shown. It is shown that any improvement in overall plant thermal efficiency reflects about the same level of gain in cost of electricity (COE). The IGCC concepts are shown to be competitive in both performance and cost at current and near-time gas turbine firing temperatures of 1985 F to 2100 F. The savings that can be accumulated over a thirty year plant life for a water-cooled gas turbine in an IGCC plant as compared to a state-of-the-art coal-fired steam plant are estimated. A total of $500 million over the life of a 1000 MW plant is projected. Also, this IGCC power plant has significant environmental advantages over equivalent coal-fired steam power plants. DOE

N81-29483# Sandia Labs., Albuquerque, N. Mex.
GUY-CABLE DESIGN AND DAMPING FOR VERTICAL-AXIS WIND TURBINES
T. G. Carne May 1981 35 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-2669) Avail: NTIS HC A03/MF A01

Guy cables are frequently used to support vertial axis wind turbines since guying the turbine reduces some of the structural requirements on the tower. The guys must be designed to provide both the required strength and the required stiffness at the top of the turbine. The axial load which the guys apply to the tower, bearings, and foundations is an undesirable consequence of using guys to support the turbine. Limitng the axial load so that it does not significantly affect the cost of the turbine is an objective of cable design. The lateral vibration of the cables is another feature of the cable design which needs to be considered. These aspects of the cable design are discussed, and a technique for damping cable vibration is mathematically analyzed and demonstrated with experimental data. DOE

N81-29527*# Energy Research Corp., Danbury, Conn.
EVALUATION OF DISTRIBUTED GAS COOLING OF PRESSURIZED PAFC FOR UTILITY POWER GENERATION Quarterly Report, Mar. - May 1981
M. Farooque, H. Maru, and A. Skok May 1981 32 p refs
(Contracts DEN3-201; DE-AI03-80E7-17088)
(NASA-CR-165304; DOE/NASA/0201/3; QR-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Two short stacks were pressure tested at 446 kPa (4.4 atm.) and the pressure gains were more than the theoretically predicted gains. Temperature profiles were observed to be independent of operating pressure. The pressure drop was found to be inversely proportional to operating pressure as expected. Continuous pressurized operation of a stack for 1000 hours verified the compatability of the fuel cell component design. A simple pressurization procedure was also developed. Six separate designs, covering two gas cooling schemes (DIGAS and separated) and two cooling channel geometries (straight through and treed), were analyzed on the net voltage output basis. Separated cooling with 5 cells per cooler was recognized to be the best among the designs considered. T.M.

N81-29528*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TESTS OF AN OVERRUNNING CLUTCH IN A WIND TURBINE Final Report
Robert C. Seidel and Henry G. Pfanner Jul. 1981 13 p refs
(Contract DE-AI01-76ET-20320)
(NASA-TM-82653; DOE/NASA/20320-32; E-914) Avail: NTIS HC A02/MF A01 CSCL 10A

An overrunning clutch that slipped freely under reverse torque was tested in the drive train of the Mod-0 wind turbine. In low variable wind conditions, the clutch engaged and disengaged smoothly without perturbation or oscillations. The clutch permitted the generator to be connected to the line using a relay instead of an automatic synchronizer. The alternator was connected to the line when the rpm reached 95% of synchronous speed and it motored to synchronous speed in about 0.15 seconds with a momentary power spike of 50 kW. The performance of the clutch was the same with and without the fluid coupling. The ideal power with the clutch was 5 to 7 kW compared to up to 50 kW without the clutch. The overrunning clutch merits consideration in future wind turbine designs as a means of simplifying the control system, increasing energy capture, and increasing the life of blades and electrical switch gear. A.R.H.

N81-29534# Southeastern Center for Electrical Engineering Education, Inc., St. Cloud, Fla.
ON-SITE FUEL CELL ENERGY SYSTEMS: THE US AIR FORCE FIELD TEST DEMONSTRATION PLAN Final Report, 30 Mar. - 30 Sep. 1980
Michael A. Aimone Dec. 1980 164 p refs
(Contract F33615-77-C-2059; AF Proj. 3145)
(AD-A100743; AFWAL-TR-80-2118) Avail: NTIS HC A08/MF A01 CSCL 10/2

The large scale application of fuel cell energy systems, electrochemical energy conversion devices, to facility operations, could result in significant benefits to the public and to the U.S. Air Force. This report summarizes the advantages and potential applications of fuel cells on an Air Force base, highlights the pertinent operational characteristics of a fuel cell, identifies the ongoing governmental and industrial programs that are aimed at commercializing this technology as early as the mid 1980's, and recommends and outlines a U.S. Air Force On-Site Fuel Cell Field Test Demonstration Program Plan. GRA

N81-29540# Regional Systems Services Group, Inc., Englewood, Colo.
ECONOMIC ANALYSIS OF WIND-POWERED FARMHOUSE AND FARM BUILDING HEATING SYSTEMS Final Report
R. W. Stafford, Frederick J. Greeb, Monica H. Smith, Craig DesChenes, and Norman L. Weaver Jan. 1981 380 p refs
(Contracts DE-AI01-76ET-20319; EX-76-A-29-1026)
(DOE/SEA-3406-20691/81/1) Avail: NTIS HC A16/MF A01

The break even values of wind energy for selected farmhouses and farm buildings focusing on the effects of thermal storage on the use of WECS production were evaluated. Farmhouse structural models include three types derived from a national survey: an older, a more modern, and a passive solar structure. The eight farm building applications include: (1) poultry layers; (2) poultry brooding/layers; (3) poultry broilers; (4) poultry turkeys; (5) swine farrowing; (6) swine growing/finishing; (7) dairy; and (8) lambing. The farm buildings represent the spectrum of animal types, heating energy use, and major contributions to national agricultural economic values. All energy analyses are based on hour by hour computations which allow for growth of animals, sensible and latent heat production, and ventilation requirements. DOE

N81-29543# Midwest Research Inst., Golden, Colo. Ocean Systems Program Branch.
OCEAN ENERGY CONVERSION SYSTEMS REPORT Annual Report
Mar. 1981 192 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-634-1011) Avail: NTIS HC A09/MF A01

Alternative power cycle concepts to the closed-cycle Rankine are evaluated and those that show potential for delivering power in a cost effective and environmentally acceptable fashion are explored. Concepts are classified according to the ocean energy resource: thermal, waves, currents, and salinity gradient. The lift of seawater entrained in a vertical steam flow provides potential energy for a conventional hydraulic turbine conversion system. Quantification of the process and assessment of potential cost must be completed to support concept evaluation. Exploratory development is completed in thermoelectricity and 2-phase nozzles for other thermal concepts. Wave energy concepts are evaluated by analysis and model testing with emphasis on pneumatic turbines and wave focussing. Several conversion approaches to ocean current energy are being evaluated. DOE

N81-29550# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy and Composites Lab.
EVALUATION OF ALLOYS FOR FUEL CELL HEAT EXCHANGES Final Report
R. A. Perkins and S. J. Vonk Apr. 1981 113 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1041-3)
(EPRI-EM-1815) Avail: NTIS HC A06/MF A01

The results are presented of an investigation to evaluate the behavior of commercial stainless steels, superalloys, and aluminide coatings in both clean (sulfur-free) and raw (1% H2S) gas representative of the Texaco slagging gasifier atmosphere are 1400 to 18000 F (1033 to 12550 K). The goal was to determine which, if any, of these materials is suitable for use in a high temperature heat exchanger operating on intermediate Btu coal gasification atmospheres. It has been found that none of the commercially available alloys or coatings are suitable for

use in the raw (1% H2S) gas, even at temperatures as low as 14000 F (10330 K). Materials that are resistant to attack either have a limited life (< 5000 h) or cannot be fabricated as large size heat exchanger components. It is concluded that structural high temperature alloys must be coated for use in the raw gas and that the best coating or cladding materials are Ni-46Cr (IN671 type alloy) and MCrAl with 25 to 40% Cr and 30 to 40% Al (where M is Ni, Co, or Fe or some combination thereof). Heat exchanger components can be clad with Ni-46Cr but the alloy must be modified to improve its reliability and performance in coal conversion atmospheres. DOE

N81-29572# Carnegie-Mellon Univ., Pittsburgh, Pa.
CONCURRENT STUDIES OF ENHANCED HEAT TRANSFER AND MATERIALS IN OCEAN THERMAL HEAT EXCHANGERS
Robert R. Bothfus Apr. 1981 78 p refs
(Contracts DE-AS02-76FT-20281; E(11-1)-2641)
(DOE/ET-20281/2) Avail: NTIS HC A05/MF A01

Vertical shell and tube condensors and evaporators with axially ridged tubes produce high heat fluxes under OTEC conditions. Shell side pressure drop is inconsequential and there are only minimal problems associated with the operation of large exchangers. Yet the cost effectiveness of ridged tube units is reduced by added material and labor costs to the point where the possible advantages of these exchangers must lie in such areas as ease of cleaning and decreased buoyancy. Units built from vertically ridged plates or sheets give promise of reducing fabricating costs while retaining the thermal and hydrodynamic benefits of ridged tubes. The dynamics of closed OTEC power cycles are dominated by the dynamics of the evaporator and condenser. Mathematical modeling of several candidate exchangers shows the OTEC cycle to be stable and bypass valve control to be a relatively fast and smooth method of turbine speed control. DOE

N81-29584# Midwest Research Inst., Kansas City, Mo. Solar Energy Research Inst.
INDUSTRIAL APPLICATIONS OF SOLAR-WIND HYBRID SYSTEMS
T. S. Jayadev and J. Henderson 1980 20 p refs
(Contract EC-77-C-01-4042)
(SERI/TP-36-096) Avail: NTIS HC A02/MF A01

Two applications of solar wind hybrid systems, designed to supply both process heat and electricity, are described for a meat packing plant and a concrete block manufacturing plant. The solar pond operates as both a heater/preheater and an elevated temperature heat souce for an electrically driven process heat pump. Electricity from the wind turbine can be used to meet any of the three loads: plant electrical demand, operation of the heat pumps, and resistive heating in the solar pond. Performance of the system is discussed. A wind system model is presented in an appendix. Some specifications and cost assessments of the systems are tabulated. DOE

N81-29589# Systems Control, Inc., Palo Alto, Calif.
OPERATION OF SMALL WIND TURBINES ON A DISTRIBUTION SYSTEM. EXECUTIVE SUMMARY
D. Curtice and James Patton Mar. 1981 26 p Prepared for Rockwell International Corp., Golden, Colo.
(Contract DE-AC04-76DP-03533)
(RFP-3177-1) Avail: NTIS HC A03/MF A01

This study analyzed technical interconnection problems associated with the dispersed wind turbine (WT) application scenario: WTs connected on distribution systems producing ac power directly or dc power fed into an inverter, without storage systems, feeding back surplus power whenever the wind is blowing. Its specific objectives included analysis of: utility personnel safety; distribution system and WT protection equipment; WTs' effects on distribution feeder voltage and regulation equipment, and line losses; and development of a method to analyze utility load-frequency control problems with load patterns produced by customer demand and the WT's intermittent power output. DOE

N81-29590# Systems Control, Inc., Palo Alto, Calif.
OPERATION OF SMALL WIND TURBINES ON A DISTRIBUTION SYSTEM Final Report
D. Curtice and James Patton Mar. 1981 190 p refs Prepared for Rockwell International Corp., Golden, Colo.
(Contract DE-AC04-76DP-03533)
(RFP-3177-2) Avail: NTIS HC A09/MF A01

This study analyzed technical interconnection problems associated with the dispersed wind turbine WT application scenario: WTs connected on distribution systems producing ac power directly or dc power fed into an inverter, without storage systems, feeding back surplus power whenever the wind is blowing. Its specific objectives included analysis of: utility personnel safety; distribution system and WT protection equipment; WTs' effects on distribution feeder voltage and regulation equipment, and line losses; and development of a method to analyze utility load-frequency control problems with load patterns produced by customer demand and the WTs' intermittent power output. DOE

N81-29595# Acres American, Inc., Columbia, Md.
SMALL HYDRO PLANT DEVELOPMENT PROGRAM. VOLUME 1: TEXT
Oct. 1980 273 p refs
(Contract DE-AC07-76ID-01570)
(DOE/ID-01570/T21-Vol-1) Avail: NTIS HC A13/MF A01

The technical and economical feasibility of using pump (turbine) induction motor (generator) packages in lieu of standardized turbogenerator units in small hydro development projects was investigated. Turbine mode performance of pumps was simulated by a computer model and selected packages covering a major part of the head flow power range were compared to equivalent standardized turbogenerator units. Topics covered include: small hydro plant sizes and existing equipment; pump types and sizes; selection of generating equipment; performance evaluations of pump turbines and generators; and an economic evaluation of pump turbine induction motor (generator) equipment. DOE

N81-29596# RAND Corp., Santa Monica, Calif.
QUANTITATIVE EVALUATION OF OCEAN THERMAL ENERGY CONVERSION (OTEC): EXECUTIVE BRIEFING
Eugene C. Gritton, Richard Y. Pei, and Ronald W. Hess Aug. 1980 50 p refs
(RAND/R-2641-DOE) Avail: NTIS HC A03/MF A01

The results of an independent quantitative evaluation of Ocean Thermal Energy Conversion (OTEC) for central station applications are summarized. A central station power plant located in the Gulf of Mexico and delivering power to the mainland United States was emphasized. The evaluation of OTEC is based on three important issues: resource availability, technical feasibility, and cost. DOE

N81-29617# Main (Charles T.), Inc., Boston, Mass.
HALF MOON COVE TIDAL PROJECT. FEASIBILITY REPORT
Nov. 1980 136 p refs
(Contract DE-FC07-80ID-12089)
(DOE/ID-12089/T1) Avail: NTIS HC A07/MF A01

The project would be located in a small cove in the northern part of Cobscook Bay in the vicinity of Eastport, Maine. The basin impounded by the barrier when full will approximate 1.2 square miles. The average tidal range at Eastport is 18.2 feet. The maximum spring tidal range will be 26.2 feet and the neap tidal range 12.8 feet. The project will be of the single pool-type single effect in which generation takes place on the ebb tide only. Utilizing an average mean tidal range of 18.2 feet the mode of operation enables generation for approximately ten and one-half (10-1/2) hours per day or slightly in excess of five (5) hours per tide. The installed capacity will be 12 MW utilizing 2 to 8 MW units. An axial flow, or Bulb type of turbine was selected for this study. DOE

N81-29621# Physical Sciences, Inc., Woburn, Mass.
SOOT CONTROL FOR FUEL-CELL ANODES; TASK NO. 10 Final Topical Report, 1 Jul. - 30 Sep. 1980
David Ham, Paul Lewis, Greg Lord, and Evan Pugh Dec. 1980 41 p refs
(Contract DE-AM21-78MC-08450)
(DOE/MC-08450/T2) Avail: NTIS HC A03/MF A01

Conditions in which soot forms on stainless steel surfaces under conditions relevant to operation of a molten carbonate fuel cell power plant are reported. Results were obtained in two different experimental configurations. It is shown that all soot was formed on a catalytic surface and not in the gas phase. Soot formation was found to be rapid for dry gas mixtures which occur between a cold gas clean up region and a fuel cell

in proposed power plant designs. Equilibrium calculations are presented which show that, over certain temperature ranges, partial equilibrium might lead to more soot than full equilibrium among the gas components. Author (DOE)

N81-29625# Sandia Labs., Albuquerque, N. Mex. Applied Mathematics Div.
SOLSTOR DESCRIPTION AND USER'S GUIDE
E. A. Arnason, D. L. Caskey, and B. C. Caskey Mar. 1981 131 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2330) Avail: NTIS HC A07/MF A01

The computer simulation code SOLSTOR is described. The code simulates energy systems in which electricity is generated by either a photovoltaic (PV) system or a wind turbine generator (WTG). Backup electricity is provided either from a utility grid or from a fuel burning generator. SOLSTOR minimizes the life cycle cost of providing energy by choosing the optimal solar or wind system component sizes. Rates for electricity purchased from the grid can include time-of-day(TOD) energy charges as well as time-of-day peak demand changes. Sell back to the grid of excess collected energy is also considered. DOE

N81-29629# Thermo Electron Corp., Waltham, Mass.
COAL-FIRED FURNACE FOR TESTING OF THERMIONIC CONVERTERS
Oct. 1980 22 p refs
(Contract DE-AC02-76ET-11292)
(TE-4258-81-81) Avail: NTIS HC A02/MF A01

The development of thermionic converter technology has progressed to make near-term applications such as the thermionic topping of a pulverized coal-fired central station powerplant. Up to now, thermionic converters have been flame tested using natural gas as fuel. A test furnace is required for evaluation of thermionic converters in a coal-fired environment. The design and costs of a facility which adapts a coal-fired furnace for thermionic converter testing are discussed. Such a facility would be exempt from air pollution regulations because of its low firing rate. DOE

N81-29645# Oak Ridge National Lab., Tenn. Fusion Energy Div.
PHYSICS OF FUSION-FUEL CYCLES
J. Rand McNally, Jr. 1981 28 p refs Presented at the Intern. Conf. on Plasma Sci., Santa Fe, N. Mex., 18-20 May 1981
(Contract W-7405-eng-26)
(CONF-810527-3) Avail: NTIS HC A03/MF A01

Nuclear fusion fuels for a magnetic fusion economy are evaluated taking into account the various technological impacts of the various fusion fuel cycles as well as the relative reactivity and the required beta's and temperature necessary for economic steady state burns. The physics of the various fusion fuel cycles (D-T, catalyzed D-D, D-He, D-Li, and the exotic fuels: He-He and the proton based fuels such as P-Li, P-Be, and P-B is reviewed including such items as (1) tritum inventory, burnup and recycle; (2) neutrons; (3) condensable fuels and ashes; (4) direct electrical recovery prospects; (5) fissile breeding, etc. The advantages as well as the disadvantages of the different fusion fuel cycles are discussed. The optimum fuel cycle from an overall standpoint of viability and potential technological considerations appears to be catalyzed D-D, which could also support smaller relatively clean, lean-D, rich-He-3 satellite reactors as well as fission reactors. DOE

N81-29694# Reynolds Metals Co., Sheffield, Ala. Energy Conversion Div.
MICROWAVE GASEOUS ELECTRODE DEVELOPMENT Final Report
M. S. Jones, Jr., K. Sathyanarayana, R. Mallavarpu, and V. Thiagarajan 31 Dec. 1980 68 p refs
(Contract DE-AC01-80ET-15619)
(DOE/ET-15619/T1) Avail: NTIS HC A04/MF A01

A microwave plasma torch was developed and tested at bench scale. The tests included: characterization of the plasma torch operating characteristics as gas composition, gas flow rate, and power input were varied; measuring the effects of magnetic fields on the plasma torch operation; measuring the effects on the plasma torch operation of an aerodynamic flow field past the exit of the torch (cold flow tests); and measurements to characterize the plasma gas temperature and electron temperature. The microwave plasma torch was installed in the anode wall of the RMC diagonal conducting wall MHD generator. Hot flow tests were conducted in the channel using unseeded combustion products, followed by tests using subsonic and supersonic flows seeded with up to 1.5 w/o potassium and magnetic fields up to 3.8 Tesla. Another concept using a microwave slot radiator to produce plasma in the MHD boundary layer was tested at the bench scale. Parameters necessary to sustain a discharge with the slot radiator open, similar to the microwave plasma torch, with argon flowing through the slots; and with the slots closed with a castable ceramic, the argon flowing past the outside of the slot were measured. DOE

N81-30198# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler.
DEVELOPMENT AND DESIGN OF A LARGE WIND-TURBINE BLADE
Michael Hahn May 1980 26 p refs
(MBB-UD-301/80-OE) Avail: NTIS HC A03/MF A01

The implementation of the mold concept in the fabrication of large blade-structures which require special surface definition and design features is described. These blades are intended for large horizontal axis windmills. Fiber reinforced composite materials produce rotor blades of high aerodynamic quality with very different profiles. It is possible to vary the stiffness of a cross-section with a given contour. Lightning protection features incorporated are described together with the protection characteristics afforded by erosion resistant paint. In the attachment area, the laminate is thickened considerably. The loads are transferred by means of prestressed studs in combination with cylindrical nuts which fit into holes bored in the thickened laminate. Author (ESA)

N81-30513*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
ADVANCED TECHNOLOGY LIGHTWEIGHT FUEL CELL PROGRAM Final Report, 31 Aug. 1979 - 28 Feb. 1981
R. E. Martin 18 Aug. 1981 95 p refs
(Contract NAS3-21293)
(NASA-CR-165417; FCR-3045) Avail: NTIS HC A05/MF A01 CSCL 10A

The potential of the alkaline electrolyte fuel cell as the power source in a multi hundred kilowatt orbital energy storage system was studied. The total system weight of an electrolysis cell energy storage system was determined. The tests demonstrated: (1) the performance stability of a platinum on carbon anode catalyst configuration after 5000 hours of testing has no loss in performance; (2) capability of the alkaline fuel cell to operate to a cyclical load profile; (3) suitability of a lightweight graphite electrolyte reservoir plate for use in the alkaline fuel cell; (4) long life potential of a hybrid polysulfone cell edge frame construction; and (5) long term stability of a fiber reinforced potassium titanate matrix structure. The power section tested operates with passive water removal eliminating the requirement for a dynamic hydrogen pump water separator thereby allowing a powerplant design with reduced weight, lower parasite power, and a potential for high reliability and extended endurance. It is concluded that two perovskites are unsuitable for use as a catalyst or as a catalyst support at the cathode of an alkaline fuel cell. E.A.K.

N81-30562*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEST RESULTS OF THE CHRYSLER UPGRADED AUTOMOTIVE GAS TURBINE ENGINE: INITIAL DESIGN Final Report
David Horvath, Guy H. Ribble, Jr., Edward L. Warren, and James C. Wood Jul. 1981 66 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-81660; DOE/NASA/51040-22; E-678) Avail: NTIS HC A04/MF A01 CSCL 10B

The upgraded engine as built to the original design was deficient in power and had excessive specific fuel consumption. A high instrumented version of the engine was tested to identify the sources of the engine problems. Analysis of the data shows the major problems to be low compressor and power turbine efficiency and excessive interstage duct losses. In addition, high HC and CO emission were measured at idle, and high NOx emissions at high energy speeds. T.M.

N81-30672# South Carolina Energy Research Inst., Columbia.
RESIDUAL ENERGY APPLICATIONS PROGRAM SYSTEMS ANALYSIS REPORT
P. W. Yngve Oct. 1980 228 p refs
(Contract DE-AC09-77ET-12866)
(DOE/ET-12866/3) Avail: NTIS HC A11/MF A01

Current DOE plans call for building an Energy Applied Systems Test (EAST) Facility at the Savannah River Plant in close proximity to the 140 to 150 F waste heat from one of several operating nuclear reactors. The waste water flow from each reactor, approximately 165,000 gpm, provides a unique opportunity to test the performance and operating characteristics of large-scale waste heat power generation and heat pump system concepts. This report provides a preliminary description of the potential end-use market, parametric data on heat pump and the power generation system technology, a preliminary listing of EAST Facility requirements, and an example of an integrated industrial park utilizing the technology to maximize economic pay back. DOE

N81-30680# Fisher (Evan D.), Bellaire, Mich.
WIND TO HEAT CONVERTER Final Technical Report
Evan D. Fisher 6 Mar. 1981 56 p
(Contract DE-FG02-79R5-10120)
(DOE/R5-10120/2) Avail: NTIS HC A04/MF A01

The feasibility of a wind driven machine which converts wind energy directly to heat was demonstrated through: the action of the impellor of a windmill driving; suitable shafting and gearing; and a rotary hydraulic brake which absorbs the power by converting the mechanical energy into heat. Resistance is created exclusively by fluid friction and agitation of the hydraulic oil circulated between the vaned members of the converter. A prototype model was constructed and erected on a hilltop site adjacent to a building. It is connected to the building's heating system and its performance is evaluated. DOE

N81-30815# Sandia Labs., Albuquerque, N. Mex. Advanced Energy Projects Div.
RECENT DARRIEUS VERTICAL-AXIS WIND TURBINE AERODYNAMICAL EXPERIMENTS AT SANDIA NATIONAL LABORATORIES
Paul C. Klimas 1981 8 p refs Presented at the 2nd DOE/NASA Wind Turbine Dyn. Workshop, Cleveland, 24 Feb. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1108C; CONF-810226-5) Avail: NTIS HC A02/MF A01

The aerodynamics of airfoils operating in the vertical axis wind turbine (VAWT) environment were examined. The experiments are intended to reduce VAWT cost of energy an increase system reliability. The experiments include: (1) chordwise pressure surveys; (2) circumferential blade acceleration surveys; (3) effects of blade camber; (4) pitch and offset; (5) blade blowing; and (6) use of sections designed specifically for VAWT application. DOE

N81-30845# New Mexico Univ., Albuquerque. Engineering Research Inst.
AUTOMATIC-CONTROL-ALGORITHM EFFECTS ON ENERGY PRODUCTION
Gerald M. McNerney 1981 9 p ref Presented at the DOE/NASA Wind Turbine Dyn. Workshop, Cleveland, 24 Feb. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-1107C; CONF-810226-6) Avail: NTIS HC A02/MF A01

Algorithm control strategy for unattended wind turbine operation, a potentially important aspect of wind energy production is discussed. A computer model was developed using actual wind time series and turbine performance data to simulate the power produced by the Sandia 17-m VAWT operating in automatic control. The model was used to investigate the influence of starting algorithms on annual energy production. The results indicate that, depending on turbine and local wind characteristics, a bad choice of a control algorithm can significantly reduce overall energy production. The model can be used to select control algorithms and threshold parameters that maximize long term energy production. DOE

N81-30847# Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht (West Germany). Zentralabteilung Technikum.
COMPARATIVE INVESTIGATIONS OF THE PERFORMANCE OF SMALL WIND ENERGY CONVERSION SYSTEMS
S. Fries, D. Borchers, and G. Petersen 1980 28 p Presented at UN/ECE Seminar on Technol. Related to New Energy Sources, Juelich, West Germany, 8-12 Dec. 1980
(GKSS-80-E-54) Avail: NTIS HC A03/MF A01

A full scale, two year test program is described for nine different 10 KW windmills at a site on the north Frisian island of Pellworm. The power plants include horizontal axis machines with two or three rotor blades (with or without blade pitch control), horizontal axis multiblade (16-to 18 blades) machines, and vertical axis machines. Electric power output, energy production, the ac frequency, the revolutions-per-minute of the converter, and the yaw angle for each horizontal axis machine are measured continuously. Wind speed, wind direction, air temperature, humidity, air pressure, and solar insolation and additional meteorological parameters for the description of climatic conditions on the site are monitored. Microprocessors are used for data processing and to control load resistances. The measurement of electric and nonelectric variables is described. Author (ESA)

N81-30903*# Virginia Associated Research Center, Newport News.
SOUND MEASUREMENTS OF THE MOD-2 WIND TURBINE GENERATOR
H. H. Hubbard, K. P. Shepherd (Bionetics Corp., Hampton, Va.), and F. W. Grosveld (Bionetics Corp., Hampton, Va.) Jul. 1981 30 p refs
(Contract NAS1-14970; Grant NAG1-166)
(NASA-CR-165752) Avail: NTIS HC A03/MF A01 CSCL 20A

Sound measurements were made for the MOD-2 wind turbine generator for wind conditions of 7.6 to 13.4 m/sec and for output power ratings of about 1 to 2 NW. Both broad band and narrow band data were obtained for a range of distances and azimuth angles from the machine. The rotor sound spectra are random in character and peak in the frequency ranges 30 to 50 Hz and 800 to 1300 Hz. Both peaks are predictable from experience with helicopter rotors and propellers. Results suggest that the lower frequency peak is due to the effects of inflow turbulence and the higher frequency peak is due to the interaction of the turbulent boundary layers with the trailing edges of the blades. The boundary layer related sound is the dominant component in the audible frequency range and determines the detectability of the machine. It could be detected at a distance of 1350 m in the upwind direction where the background noise was 30 dB (A) and at distances in excess of 2100 m in the downwind direction. Discrete frequency sound components associated with the power generation equipment are measurable in the direction normal to the axis of rotation but are not believed to be significant for detection or community response. M.G.

N81-30973*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A PROGRAM-MANAGEMENT PLAN WITH CRITICAL-PATH DEFINITION FOR COMBUSTION AUGMENTATION WITH THERMIONIC ENERGY CONVERSION (CATEC)
James F. Morris, Owen S. Merrill (DOE, Washington, D.C.), and Harsha K. Reddy (The Aerospace Corp., Los Angeles) 1981 50 p refs Presented at Intern. Conf. on Plasma Sci., Santa Fe, N. Mex., 18-20 May 1981
(Contract EC-77-A-31-1062)
(NASA-TM-82670; E-950; DOE/NASA/1062-0) Avail: NTIS HC A03/MF A01 CSCL 20I

Thermionic energy conversion (TEC) is discussed. In recent TEC-topping analyses, overall plant efficiency (OPE) and cost of electricity (COE) improved slightly with current capabilities and substantially with fully matured technologies. Enhanced credibility derives from proven hot-corrosion protection for TEC by silicon-carbide clads in fossil fuel combustion products. Combustion augmentation with TEC (CATEC) affords minimal cost and plant perturbation, but with smaller OPE and COE improvements than more conventional topping applications. Risk minimization as well as comparative simplicity and convenience, favor CATEC for early market penetration. A program-management plan is proposed. Inputs, characteristics, outputs and capabilities are discussed. S.F.

N81-31404# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

PERFORMANCE ANALYSIS OF DEDICATED HEAT-PUMP WATER HEATERS IN AN OFFICE BUILDING

L. Merrigan May 1981 13 p refs Presented at the 3rd Conf. on Waste Heat Management and Utilization, Miami, Fla., 11-13 May 1981

(Contracts DE-AC02-77CH-0017; EG-77-C-01-4042)

(SERI/TP-721-1198; CONF-810545-4) Avail: NTIS HC A02/MF A01

The performance of two generic dedicated heat pump water heaters, (HPWHs) in supplying the domestic hot water (DHW) needs of a medium sized office building were evaluated. Data measurements and assumptions were made to compensate for a faulty flow meter. A stand alone heat pump plumbed to a conventional tank obtains a coefficient of performance (COP) of 2.4 but only delivers load water temperatures of about 41 C. An integral heat pump/tank unit was tested. Recirculating loop losses account for 75% of the energy delivered by the JPWHs. It is suggested that these losses be reduced by 75% if the recirculating loop were insulated. DOE

N81-31518# Tennessee Univ. Space Inst., Tullahoma. Energy Conversion Div.

DEVELOPMENT AND HEAT TRANSFER ANALYSIS OF DIRECT COAL FIRED MHD COMBUSTORS

G. D. Roy and R. C. Attig Jun. 1981 71 p refs

(Contract DE-AC02-79ET-10815)

(DOE/ET-10815/T4) Avail: NTIS HC A04/MF A01

The performance of the generator as a function of the combustor geometry and other factors (MHD combustor/generator interaction); knowledge of the heat flux distribution and the heat losses of various locations were studied. The heat loss in the coal combustor increases the cost of electricity and should thus be kept at a minimum. For higher conductivities, the thermal energy of the coal should be relased as completely as possible. Since the resulting performance of the generator is the best criterion of combustor selection, detailed combustor/generator interaction testing was undertaken. Heat transfer was used as one diagnostic tool among others. Details of this testing and data analysis are presented. T.M.

N81-31584# Curtiss-Wright Corp., Wood-Ridge, N.J. Power Systems Div.

HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM, PHASE 2: TECHNOLOGY TEST AND SUPPORT STUDIES Technical Progress Report, 1 Mar. - 31 Mar. 1981

Apr. 1981 9 p refs

(Contract DE-AC01-76ET-10348)

(CW-WR-78-02086; FE-2291-86) Avail: NTIS HC A02/MF A01

The technology of a high temperature, multistage, power turbine subsystem was advanced to a technology readiness condition. Technical data required to complete the turbine subsystem designs were tested. DOE

N81-31627*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

RESULTS OF THE ETV-1 BREADBOARD TESTS UNDER STEADY-STATE AND TRANSIENT CONDITIONS

Noel B. Sargent and Miles O. Dustin Aug. 1981 16 p refs Presented at the Elec. Vehicle Council Symp. 6, Baltimore, 21-23 Oct. 1981

(Contract DE-A101-77CS-51044)

(NASA-TM-82667; E-844; DOE/NASA/51044-21) Avail: NTIS HC A02/MF A01 CSCL 10A

Steady state tests were run to characterize the system and component efficiencies over the complete speed-torque capabilities of the propulsion system in both motoring and regenerative modes of operation. The steady state data were obtained using a battery simulator to separate the effects on efficiency caused by changing battery state-of-charge and component temperature. Transient tests were performed to determine the energy profiles of the propulsion system operating over the SAE J227a driving schedules. T.M.

N81-31628*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

GENERAL REVIEW OF THE MOSTAS COMPUTER CODE FOR WIND TURBINES

John Dungundji and John H. Wendell Jun. 1981 75 p refs

(Grant NsG-3303; Contract DE-AI01-76ET-20320)

(NASA-CR-165385; DOE/NASA/3303-1; ASRL-TR-197-1) Avail: NTIS HC A04/MF A01 CSCL 10A

The MOSTAS computer code for wind turbine analysis is reviewed, and techniques and methods used in its analyses are described. Impressions of its strengths and weakness, and recommendations for its application, modification, and further development are made. Basic techniques used in wind turbine stability and response analyses for systems with constant and periodic coefficients are reviewed. E.A.K.

N81-31629*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

AEROELASTIC ANALYSIS OF A TROPOSKIEN-TYPE WIND TURBINE BLADE

F. Nitzsche Hampton, Va. NASA Langley Research Center Jul. 1981 12 p refs Presented at the Intern. Colloq. on Wind Energy, Brighton, England, Aug. 1981

(Grant NGL-05-020-243)

(NASA-CR-165764) Avail: NTIS HC A02/MF A01 CSCL 10B

The linear aeroelastic equations for one curved blade of a vertical axis wind turbine in state vector form are presented. The method is based on a simple integrating matrix scheme together with the transfer matrix idea. The method is proposed as a convenient way of solving the associated eigenvalue problem for general support conditions. E.A.K.

N81-31632*# Avco-Everett Research Lab., Mass.

CONCEPTUAL DESIGN STUDY OF POTENTIAL EARLY COMMERCIAL MHD POWERPLANT, REPORT OF TASK 2 RESULTS Final Report

Finn A. Hals Mar. 1981 247 p refs

(Contracts DEN3-51; DE-AI01-77ET-10769)

(NASA-CR-165235; DOE/NASA/0051-2) Avail: NTIS HC A11/MF A01 CSCL 10B

The conceptual design of one of the potential early commercial MHD power plants was studied. The plant employs oxygen enrichment of the combustion air and preheating of this oxygen enriched air to an intermediate temperature of 1200 F attainable with a tubular type recuperative heat exchanger. Conceptual designs of plant componets and equipment with performance, operational characteristics, and costs are reported. Plant economics and overall performance including full and part load operation are reviewed. The projected performance and estimated cost of this early MHD plant are compared to conventional power plants, although it does not offer the same high efficiency and low costs as the mature MHD power plant. Environmental aspects and the methods incorporated in plant design for emission control of sulfur and nitrogen are reviewed. E.A.K.

N81-31649# Oak Ridge National Lab., Tenn.

NET ENERGY OF SEVEN SMALL-SCALE HYDROELECTRIC POWER PLANTS Final Report

M. W. Gilliland, J. M. Klopatek, and S. G. Hildebrand Jul. 1981 119 p refs

(Contract W-7405-eng-26)

(ORNL/TM-7694; ESD-PUBL-1678) Avail: NTIS HC A06/MF A01

The net energy results are expressed as the ratio of energy output to energy input. Two ratios were developed. In the first (R1), the energy output, expressed as electrically, was divided by the energy subsidy; in the second (R2), the energy output, expressed as the fossil fuel equivalent of electricity, was divided by the energy input. The results indicate that the energy output from the seven plants is 8.6 to 32.9 times greater than the energy input for the R1 case, and 26.3 to 101.4 times greater than the energy input for the R2 case. On the net energy criterion, the small scale plants are better than conventional peak load hydroelectric plants and similar to conventional base load hydroelectric plants. DOE

N81-31661# Lockheed Missiles and Space Co., Sunnyvale, Calif. Ocean Energy Systems.

OCEAN THERMAL ENERGY CONVERSION POWER SYSTEM DEVELOPMENT-2, PHASE 2 Final Design Report

1 Jun. 1981 160 p refs

(Contracts DE-AC02-78ET-21056; ET-78-C-01-3407)

(DOE/ET-21056/T3) Avail: NTIS HC A08/MF A01

The detailed design of the power system development is presented. The trade studies and related investigations are

reviewed. The design and functional requirements for the 10 MW(e) power system and the 0.2 MW(e) heat exchanger test articles are listed. The primary objectives of the total program are given. The major test article components and the related biofouling and corrosion countermeasures are discussed. Performance and diagnostic instrumentation and related data analysis, a proposed OTEC-1 test article installation, and a recommended plan for the conduct of the test program are presented. DOE

N81-31882# Acres American, Inc., Columbia, Md.
SMALL HYDRO PLANT DEVELOPMENT PROGRAM
Oct. 1980 322 p refs Prepared for Edgerton, Germeshausen and Grier, Idaho Falls, Idaho
(Contract DE-AC07-76ID-01570)
(DOE/ID-01570/T21-Vol-2-App-A-K) Avail: NTIS HC A14/MF A01

The technical and economic feasibility of using pump turbine - induction motor (generators) packages in lieu of standardized turbogenerator units in small hydro development projects was reported. The following topics are considered: (1) listing of Hydroelectric Power Resources by State; (2) Manufacturers' Data on Standardized Hydroturbines; (3) Inventory of Available Pumping Equipment; (4) Characteristics of Representative Pumps; (5) Survey of Pump Manufacturers and Engineering Firms; (6) Model Pump Mode and Turbine Mode Characteristics; (7) Prototype Turbine Mode Characteristics; (8) Pump (Turbine) Motor (Generator) Equipment Packages; (9) Manufacturers' Data on Components of Equipment Packages; (10) Overspeed Calculations; and (11) Economic Evaluation.DOE

N81-32026*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH B-FIELD, LARGE AREA RATIO MHD DUCT EXPERIMENTS
J. Marlin Smith, Shih-Ying Wang, and J. L. Morgan 1981 14 p refs Presented at the Intern. Conf. on Plasma Sci., Santa Fe, N. Mex. 18-20 May 1981; Sponsored by IEEE
(Contract DE-AI01-77ET-10769)
(NASA-TM-82673; E-956; DOE/NASA/10769-10) Avail: NTIS HC A02/MF A01 CSCL 20I

Studies of the effect of area ratio variation on the performance of a supersonic Hall MHD duct were extended up to area ratios of 6.25/1. It is shown that for a given area ratio there is a combustion pressure above which the power generating region of the duct is shock free and the power output increases linearly with the square of the magnetic field. Below this pressure a shock forms in the duct which moves upstream with increasing magnetic field strength and results in a less rapid rise in power output. Author

N81-32035# Stanford Linear Accelerator Center, Calif.
STATUS OF THE US HEAVY ION FUSION PROGRAM
W. B. Herrmannsfeldt Apr. 1981 20 p refs Presented at the Workshop on the Application of the SNS to Heavy Ion Fusion, Abingdon, England, 23-26 Mar. 1981
(Contract DE-AC03-76SF-00515)
(SLAC-Pub-2722; CONF-810375-1) Avail: NTIS HC A02/MF A01

The US heavy ion fusion (HIF) program is reviewed. The political situation is discussed and then the technical justification for the interest in HIF is presented. This is followed by a brief description of the Argonne Program to develop the rf linac storage ring system for which the spallatron neutron source can contribute important data. The direction being taken by the Berkeley group to develop the induction linac system is described. DOE

N81-32087*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-POWER BASELINE AND MOTORING TEST RESULTS FOR THE GPU-3 STIRLING ENGINE Final Report
Lenny G. Thieme Jun. 1981 37 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-82646; DOE/NASA-51040-31; E-902) Avail: NTIS HC A03/MF A01 CSCL 13F

Test results are given for the full power range of the engine with both helium and hydrogen working fluids. Comparisons are made to previous testing using an alternator and resistance load bank to absorb the engine output. Indicated power results are presented as determined by several methods. Motoring tests were run to aid in determining engine mechanical losses. Comparisons are made between the results of motoring and energy-balance methods for finding mechanical losses. T.M.

N81-32163# Stuttgart Univ. (West Germany). Inst. fur Aerodynamik und Gasdynamik.
A GUST GENERATOR FOR WIND TURBINES [EIN BOEENGENERATOR FUER WINDTURBINEN]
F. X. Wortmann 9 Apr. 1979 8 p In GERMAN
(Contract BMFT-PLE-ET-4066-A)
(IAG-79-6) Avail: NTIS HC A02/MF A01

A gust generator is proposed which can be used to study the mechanical characteristics of full size experimental windpowered machines. In conjunction with a wind tunnel, the device would simulate gale force winds as well as variable winds normally encountered by windmill design machines in the course of their work cycle. The utility of such an apparatus is emphasized, its characteristics are detailed, and an estimate of its cost to build is given. Author (ESA)

N81-32214# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
ELECTRODE SURFACE CHEMISTRY Annual Report, FY 1980
Philip N. Ross, Jr. Sep. 1980 15 p
(Contract W-7405-eng-48)
(LBL-12638) Avail: NTIS HC A02/MF A01

Attempts were made to develop the physical and chemical understanding of oxygen-platinum-alloy ligand interaction necessary for the rational selection of alloying components. The experimental approach combines the study of the interaction of the oxygen molecule with bimetallic surface in vacuum and in aqueous solution in a single apparatus. This apparatus combines classical electrochemical methods together with the analytical methods of surface science: low energy electron diffraction; Auger electron spectroscopy; photoemission spectroscopy; and thermal desorption mass spectroscopy. DOE

N81-32224# General Electric Co., Philadelphia, Pa. Management and Technical Services Co.
OPERATION, MAINTENANCE AND MODIFICATION OF DOE/PETC TWO STAGE MHD PRESSURIZED COAL COMBUSTOR Final Activity Report, Jul. 1976 - 15 Nov. 1980
R. B. Bradfield 1980 131 p refs
(Contract DE-AC02-76PC-04049)
(DE81-025971; DOE/PC-04049/T1) Avail: NTIS HC A07/MF A01

The primary objective of the DOE/PETC program is to obtain definitive process information from the two stage 5 MW MHD pressurized coal combustor to allow scaling of the combustor to 50 MW thermal for the CDIF facility to be located in the Butte, Montana area. Activities are described according to the following phases: (1) facility preparation; (2) facility start-up and operating adjustment period; (3) process investigation operations; (4) major facility scroll combustor modification; (5) scroll combustor shakedown testing; (6) AVCO diagnostic test section redesign and installation; (7) scroll combustor testing with diagnostic test section installed; and (8) facility downmode. Diagrams and engineering drawings of the facility are included. DOE

N81-32300# Florida Power and Light Co., Miami.
BASELINE DATA ON UTILIZATION OF LOW-GRADE FUELS IN GAS-TURBINE APPLICATIONS. VOLUME 1: ECONOMIC COMPARISONS Final Report
R. J. Burgess Jun. 1981 132 p Sponsored by EPRI
(EPRI Proj. 1079-1)
(EPRI-AP-1882-Vol-1) Avail: NTIS HC A07/MF A01

The costs and operating factors of a combined cycle power plant when firing No. 2 fuel compared to firing a blended low sulfur residual fuel oil are described. Results are based on exclusively firing No. 2 oil in one 260 MW(e) unit comprised of two gas turbines, two heat recovery steam generators and a steam turbine, while firing the lower grade fuel in the twin 260 MW(e) unit under a similar load and weather conditions as practicable. Some operating problems with heavy fuel firing were resolved. These problems on heavy fuel included fuel filter plugging, flow divider failure, combustor and turbine deposition, apparent compressor surge, and oily fuels wash system effluent water. Though these circumstances tended to mask the exact cost differentials between operations on the two fuels, it is found

that a $2.00/bbl fuel price differential justifies using the lower grade fuel at all capacity factors when the plant is already equipped to handle heavy fuels. For a plant that is not equipped to fire heavy fuels, if a $12.5 million fuel cleaning system investment is made at a 23% levelized annual carrying charge, a @2.00/bbl fuel price differential breaks even at a 0.5 capacity factor despite the higher maintenance costs and fuel cleaning costs incurred when firing low grade fuel. DOE

N81-32307# Westinghouse Electric Corp., Large, Pa. Advanced Energy Systems Div.
EFFECT OF ALTERNATE FUELS ON THE PERFORMANCE AND ECONOMICS OF DISPERSED FUEL CELLS Final Report
J. J. Buggy, B. R. Krasicki, J. R. Lance, B. L. Pierce, and L. E. VanBibber Jul. 1981 187 p refs Sponsored by EPRI
(EPRI Proj. 1041-7)
(EPRI-EM-1936) Avail: NTIS HC A09/MF A01

An assessment of the effects of alternative fuels (natural gas, coal derived medium-Btu gas, methanol, ethanol, and naphtha) on the performance and economics of conceptual phosphoric acid fuel cell (PAFC) power plants is presented. Properties of typical examples of these fuels, PAFC requirements for preliminary specification for fuel processing systems, and vendor-supplied cost, performance, and operational data on fuel processing systems to define ten PAFC power plant configurations utilizing the five alternatives fuels are addressed. DOE

N81-32397*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
THE 40-KW FIELD TEST POWER PLANT MODIFICATION AND DEVELOPMENT, PHASE 2 Annual Report, 1 Jul. 1978 - 30 Jun. 1979
15 Aug. 1980 129 p Sponsored in part by NASA and GRI
(Contracts DE-AC01-77ET-11302; ET-77-C-03-1471)
(NASA-CR-164794; FCR-2067) Avail: NTIS HC A07/MF A01 CSCL 10B

Progression on the design and development of a 40 KW fuel cell system for on-site installation for providing both thermal and electrical power is reported. Development of the steam reformer fuel processor, power section, inverter, control system, and thermal management and water treatment systems is described. DOE

N81-32448# Fluidyne Engineering Corp., Minneapolis, Minn.
MHD AIR-HEATER TECHNOLOGY DEVELOPMENT Technical Progress Program, 1 Jan. 1981 - 31 Mar. 1981
Apr. 1981 44 p refs
(Contract DE-AC01-80ET-15602)
(DE81-026605; DOE/ET-15602/T5) Avail: NTIS HC A03/MF A01

Technology development of the directly-fired high temperature air heater (HTAH) for magnetohydrodynamics power plants is reported. The selection of ceramic materials for the valve testing facility (VTF) and matrix test facility (MTF) and sample collection from the MTF were accomplished. Modifications performed to the VTF hot gas supply duct, preparation for the startup of VTF Test 4, and the design of modifications to the MTF are described. Preliminary investigations of performance and control studies of a 1000 MW power plant were begun. DOE

N81-32464# Oak Ridge National Lab., Tenn. Engineering Technology Div.
CRAWL SPACE-ASSISTED HEAT PUMPS
Ralph N. McGill 1981 10 p refs Presented at the DOE Heat Pump Contractors Program Integration Meeting, McLean, Va., 2-4 Jun. 1981
(Contract W-7405-eng-26)
(DE81-023221; CONF-810672-17) Avail: NTIS HC A02/MF A01

By means of field tests in real houses, it was found that the source air for the heat pump can be preheated (or precooled) by drawing the outdoor air through the crawl space before it is used by the heat pump. The outdoor air is warmed (or cooled) by flowing over the crawl space earth. Most of the data is from winter months, when one would expect the most benefit for heat pump performance. Generally, greater preheating occurs at lower outdoor air temperatures; and, the effect tapers off to virtually no gain at about 10 C. The preheating effect has been shown to be sustained for an entire winter season. Another experiment proved that the preheating does come, in great part, from the earth and not simply from the house above. Analysis had also led to the conclusion that the heat transfer mechanism is by simple conduction within the upper 0.3 m of the crawl space earth. DOE

N81-32617# Tectonics Research, Inc., Minneapolis, Minn.
TEST AND DEMONSTRATION OF A HERMETIC COMPRESSOR SEAL. PHASE 1: DEVELOPMENT OF A BRAUN LINEAR ENGINE-DRIVEN HEAT-ACTUATED HEAT PUMP
A. T. Braun 1981 5 p refs Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981 Prepared for Oak Ridge National Lab.
(Contract W-7405-eng-26)
(DE81-024099; CONF-810672-12) Avail: NTIS HC A02/MF A01

A viable hermetic seal to advance the state of development, through analyses, simulation, design, fabrication and testing, of the key elements and components of the Braun linear engine/compressor was developed. The purpose was to develop: (1) a sound basis for a reliable light-commercial sized heat pump system; (2) evaluate integral heat recovery and defrost systems; (3) necessary controls; and (4) preliminary prototype heat pump system specifications. The concept, technical accomplishments, and future activities are summarized. DOE

N81-32630# Midwest Research Inst., Golden, Colo.
ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT: DYNAMIC INDUCER SYSTEM, EXECUTIVE SUMMARY
P. B. S. Lissaman, A. D. Zalay, and B. H. Hibbs May 1981 16 p Prepared in cooperation with AeroVironment, Inc., Pasadena, Calif.
(Contract DE-AC02-77CH-00178)
(SERI/TR-8085-1-T1) Avail: NTIS HC A02/MF A01

Concepts to improve the technical and economic performance of wind energy conversion systems (WECS) were examined. One technique for improving the cost-effectiveness of WECS is the use of tip vanes. Tip vanes are small airfoils attached approximately at right angles to the rotor tips with their span oriented approximately parallel to the local freestream. The performance benefits of the dynamic inducer tip vane system were demonstrated Tow-tests conducted on a three-bladed, 3.6-meter diameter rotor show that a dynamic inducer can achieve a power coefficient of 0.5, which exceeds that of a plain rotor by about 35%. DOE

N81-32631# Midwest Research Inst., Golden, Colo.
ADVANCED AND INNOVATIVE WIND ENERGY CONCEPT DEVELOPMENT: DYNAMIC INDUCER SYSTEM
P. B. S. Lissaman, A. D. Zalay, and B. H. Hibbs May 1981 89 p refs Prepared in cooperation with AeroVironment, Inc., Pasadena, Calif.
(Contract DE-AC02-77CH-00178)
(SERI/TR-8085-1-T2) Avail: NTIS HC A05/MF A01

The performance benefits of the dynamic inducer tip vane system was demonstrated Tow-tests conducted on a three-bladed, 3.6-meter diameter rotor show that a dynamic inducer can achieve a power coefficient (based pon power blade swept area) of 0.5, which exceeds that of a plain rotor by about 35%. Wind tunnel tests conducted on a one-third scale model of the dynamic inducer achieved a power coefficient of 0.62 which exceeded that of a plain rotor by about 70%. The dynamic inducer substantially improves the performance of conventional rotors and indications are that higher power coefficients can be achieved through additional aerodynamic optimization. DOE

N81-32633# Midwest Research Inst., Golden, Colo.
REPORT ON THE ELECTROFLUID DYNAMIC WIND GENERATOR Final Report, 1 Apr. 1979 - 31 Aug. 1980
John E. Minardi, Maurice O. Lawson, and Frank L. Wattendorf May 1981 48 p refs Prepared in cooperation with Dayton Univ. Research Foundation, Ohio
(Contracts DE-AC02-77CH-00178; DE-AS02-78ET-20258; EY-76-S-02-4130)
(DOE/ET-20258/T1; UDR-TR-80-108) Avail: NTIS HC A03/MF A01

In an EFD generator, charge particles of one polarity are seeded into a flowing neutral gas. Viscous interactions with neutral molecules drive the charged particles against an electrical potential

and produce dc power of low current density and very high voltage. Demonstration of an energy economic method of producing and distributing low mobility charged droplets is described. DOE

N81-32660# South Carolina Energy Research Inst., Columbia.
SOUTH CAROLINA APPLICATIONS FOR INDUSTRIAL WASTE-HEAT RECOVERY USING HEAT PUMPS AND RANKINE-CYCLE POWER-GENERATION SYSTEMS
F. J. McCrosson and K. A. Murray Jul. 1981 77 p refs
(Contract DE-AC09-77ET-12866)
(DOE/ET-12866/9) Avail: NTIS HC A05/MF A01

The industries include: textile finishing, pulp and paper, noncellulosic fibers, pressed and blown glass, hydraulic cement, and secondary nonferrous metals. Thermodynamic and economic calculations determined system outputs and after-tax rates of return. The number of applications and net system outputs for the United States and for South Carolina were estimated. DOE

N81-32669# San Diego Gas and Electric Co., Calif.
HEBER GEOTHERMAL BINARY DEMONSTRATION PROJECT Quarterly Technical Progress Report, 15 Sep. 1980 - 31 Mar. 1981
W. H. Hanenburg, R. G. Lacy, and G. D. YanDeMark Jun. 1981 32 p refs
(Contract DE-FC03-80RA-50239)
(DE81-027446; DOE/RA-50239/1; QTPR-1) Avail: NTIS HC A02/MF A01

Topics covered include progress made in the areas of wells and fluids production and injection systems. Power plant design and construction, power plant demonstration, and data acquisition and dissemination are discussed. DOE

N81-32670# Tudor Engineering Co., San Francisco, Calif.
FEASIBILITY REPORT ON THE POTENTIAL HYDROELECTRIC DEVELOPMENT AT COMBIE DAM
Oct. 1980 141 p Prepared in cooperation with Nevada Irrigation District, Grass Valley, Calif.
(Contract DE-FM07-80ID-49004)
(DE81-026670; DOE/ID-49004/1; WP-113-254-TC) Avail: NTIS HC A07/MF A01

The power plant would utilize flows which presently pass over the dam's spillway. The project would involve expanding the existing four foot diameter outlet on the southern gravity portion of the dam, installing a penstock and constructing a 3500 kilowatts (kW) power plant on the south bank of the river below the dam. The capital cost of the project, including interest during construction, would total approximately $4,500,000 in July 1980 Dollars. The unit capacity cost of the project at the 1980 price level would be $1,285 per kilowatt. The energy production unit cost would be 41.4 mills per kilowatt hour in 1980, and 56.3 mills per kilowatt hour in 1984. The primary conclusion is that the project is economically, environmentally and institutionally viable, and continued escalation of energy values will make this project even more attractive. DOE

N81-32673# Oklahoma State Univ., Stillwater. Engineering Energy Lab.
SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 8: WIND ENERGY
William L. Hughes, R. G. Ramakumar, and Dan D. Lingelbach Apr. 1981 143 p refs Prepared in cooperation with Univ. of Central Florida, Orlando
(DE81-029009; DOE/CS-30278/T10) Avail: NTIS HC A07/MF A01

A historical perspective of wind energy utilization, and the potential uses of wind were examined and the economic costs and technical difficulties of using it. The statistical characteristics of the wind for a moderate to high wind area in the United States are discussed. Information on average available energy on an annual basis is presented along with approximately monthly variations. An extensive variety of types of windmills, and a sampling of these varieties is discussed. Data on efficiencies and power coefficients for a variety of turbines are also presented. DOE

N81-32678# Jacobs Energy Research, Inc., Audubon, Minn.
HYDRAULIC WIND ENERGY CONVERSION SYSTEM
Jul. 1981 18 p ref
(Contract DE-FG02-80R5-10236)
(DE81-027122; DOE/R5-10236/2) Avail: NTIS HC A02/MF A01

The purpose of this research was to design, build and test a hydraulic wind energy system. This design used a three bladed turbine, which drove a hydraulic pump. The energy is transmitted from the pump through a long hose and into a hydraulic motor, where the energy is used. This wind system was built and tested during the winter of 1980-1981. The power train included a five meter, three bladed wind turbine, a 9.8:1 ratio gearbox, a 1.44 cubic inch displacement pump with a small supercharge gear pump attached. The hydraulic fluid was pumped through a 70 ft, 3/4 in. I-D-high pressure flexhose, then through a volume control valve and into a 1.44 cubic inch displacement motor. The fluid was returned through a 7 ft, 1 in. I-D-flexhose. DOE

N81-32685# Argonne National Lab., Ill.
DEVELOPMENT OF A TUBULAR LITHIUM-IRON SULFIDE CELL
Y. W. Park (Korea Inst. of Science and Technology, Seoul) and H. Shimotake 1980 14 p refs Presented at the 15th Intersoc. Energy Conversion Eng. Conf., Seattle, 18-22 Aug. 1980
(Contract W-31-109-eng-38)
(DE81-023126; CONF-800806-47) Avail: NTIS HC A02/MF A01

Applications of the cell include power sources for electric-vehicle propulsion and stationary energy storage for load leveling in electric utility networks. Performance requirements for these applications are high specific energy, high volumetric energy density, and high specific power. A tubular cell design in which a cylindrical electrode surrounded by an annular shaped electrode of the opposite polarity was adopted to produce low-cost cells such as LeClanche cells and Ni-Cd cells. This design may offer low-cost alternatives to the current prismatic and cylindrical cell designs. The tubular Li/FeS cells currently being developed are discussed. DOE

N81-32693# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 1: SUMMARY. PART 2: COMPACT FUEL CELL SET Final Report
Horst Gruene, Karl Hoehne, Karl Strasser, Botho Stuewe, and Hans Fetzer Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 614 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-055-Vol-1/2; ISSN-0340-7608) Avail: NTIS HC A99/MF A01

A 7kW compact hydrogen oxygen fuel cell was developed with considerably improved specific power capabilities. The unit, consisting of a total of 70 cells with alkali electrolytes, is described and details on catalysts, electrode construction, electrolyte regenerator and electromechanical and electronic control are included. Prototype tests show the attainment of the envisaged specific power. This is attributed to an increase in power density and to the particular design concept. While certain components need further improvements, the overall feasibility of economical manufacturing, due to the production methods employed, is demonstrated. Author (ESA)

N81-32694# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 3: PRELIMINARY WORK FOR THE MANUFACTURE OF TEN SEVEN kW PROTOTYPE AGGREGATES IN THE KUNSTOFF UND PRESSWERK, REDWITZ Final Report
Dieter Weyl Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 39 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-056-Vol-3; ISSN-0340-7608) Avail: NTIS HC A03/MF A01

The production processes developed in the laboratory for the manufacturing of 7 kW fuel cell units were examined under factory conditions. The optimization of the production parameters of catalysts, electrodes, and plastic frames is described as well as production and assembly equipment. Experience gained in the manufacturing of the electrolyte regenerator and the control units is reported. In view of the progress made, it was decided

to manufacture of components for the prototype aggregates. Author (ESA)

N81-32896# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 4: ACCOMPANYING RESEARCH AND DEVELOPMENT Final Report
Konrad Mund Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 171 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-057-Vol-4; ISSN-0340-7608) Avail: NTIS HC A08/MF A01

Models describing the electrochemical kinetics at porous H2 and O2 electrodes using Raney nickel and silver catalysts were developed and their parameters determined by means of stationary and impedance measurements. A correct description of the hydrogen electrode with a Raney nickel catalyst is shown to encompass proper consideration of both diffusion in the pore electrolyte and surface diffusion. Impedance measurements yield a surface diffusion coefficient of 10 sub-8 sq cm sub-1. The addition of titanium to the catalyst results in decreased electrode polarization and higher stability. Highly active doped silver catalysts are shown to allow high current densities and diaphragm resistances as low as 3 ohm cm at the oxygen electrode. Service tests show adequate stability of the catalysts. Author (ESA)

N81-32897# Siemens A.G., Erlangen (West Germany). Forschungslab.
TWENTY kW FUEL CELL UNITS OF COMPACT DESIGN. PART 6: USE OF FUEL CELL AGGREGATES AND ENERGY CONVERSION. PART 7: CONCEPT AND DESIGN STUDIES FOR SPECIAL STANDBY POWER SUPPLIES Final Report
Ruediger Braun Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 71 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 5 Vol.
(BMFT-FB-T-80-059-Vol-6/7; ISSN-0340-7608) Avail: NTIS HC A04/MF A01

Dimensioning and circuit arrangement of fuel cell aggregates of different capacity built up from the basic 7 kW unit are discussed as well as the electrical design of dc and ac converters. Battery overlap, cold operation and water removal under reduced load conditions are considered. Two specific applications are studied: a 20kVA fully automated standby unit for hospitals; and a movable 1.5kVA standby unit. The former investigation is mainly concerned with the system information flow and automation. The latter aims at optimizing dimensions and weight. The role of fuel cells in improving the availability of public power supply systems is finally assessed. Author (ESA)

N81-33038# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 7: MHD APPENDIX (BIBLIOGRAPHY, PATENT DISCLOSURES, SUPPLEMENTARY DWGS) Final Report, 15 Oct. 1973 - 31 Dec. 1976
William E. Young Nov. 1980 62 p refs
(Contract DE-AC01-76ET-10805)
(DE81026197; DOE/ET-10805/T1-Vol-7) Avail: NTIS HC A04/MF A01

The seven-section bibliography cites nearly 200 reports, memos, and technical papers, and includes not only those completed during the contract time frame, but some that lead up to and are subsequent to the contract period. A listing of 66 patent disclosures (and patents) and 27 assembly drawings, including reference to the associated details is included. DOE

N81-33056# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
KEY CONTRIBUTIONS IN MHD POWER GENERATION Quarterly Technical Progress Report, 1 Dec. 1979 - 29 Feb. 1980
J. F. Louis Sep. 1980 177 p
(Contract DE-AC01-79ET-15518)
(DE81-025174; DOE/ET-15518/4) Avail: NTIS HC A09/MF A01

Arcing phenomena in MHD generator open cycle MHD disk generator program electrode module development and testing and coal combustion studies are addressed. DOE

N81-33057# Stanford Univ., Calif. High Temperature Gasdynamics Lab.
HIGH-MAGNETIC-FIELD MHD-GENERATOR PROGRAM Quarterly Report, 1 Jan. - 31 Mar. 1981
C. H. Kruger, R. H. Eustis, M. Mitchner, S. A. Self, J. K. Koester, and T. Nakamura Apr. 1981 80 p refs
(Contract DE-AC01-80ET-15611)
(DE81-025560; DOE/ET-15611/T2) Avail: NTIS HC A05/MF A01

Channel phenomena which are important at high magnetic fields are investigated. Nonuniformity effects, boundary layers, hall field breakdown, the effects of electrode configuration and current concentrations, and studies of steady state combustion disk and linear channels in a 6 Tesla magnet of small dimensions were studied. A multi-channel fiber optics diagnostic system is described. A one dimensional model to describe the performance of a non-ideal MHD generator was developed. A two dimensional MHD computer code was developed which predicts the dependence on electrode and insulator dimensions of the onset of interelectrode Hall field breakdown. Calculations of the effects of nonuniformities on the flow and electrical behavior of baseload-sized disk generators were performed. DOE

N81-33059# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 2: MHD CHANNEL EXPERIMENTS Final Report, 15 Oct. 1973 - 31 Dec. 1975
William E. Young and Abner B. Turner Nov. 1980 822 p refs
(Contract DE-AC01-76ET-10805)
(DE81-026202; DOE/ET-10805/T1-Vol-2; FE-1540-29) Avail: NTIS HC A99/MF A01

An MHD generator facility for evaluating and developing hot channel materials and structures was constructed with about a 4.0 MW thermal rating and with a gas flow of 1.47 kg/second. A flexible design accommodated various internal sidewall and electrode constructions. The facility consisted of an indirect fired air preheater with air supplied from a 350 HP rotary compressor, a combustion system capable of producing a working gas equivalent in all respects to products of combustion of coal and air, fuel and gas supplies with adequate metering facilities, a mixing charger, provision for seed injection, an MHD generator duct with a conventional iron core magnet of 30,000 gauss maximum field, a back pressure valve to control duct pressure under all generating conditions, and a gas scrubbing system. Facility design and results from the hot run tests are presented. DOE

N81-33060# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS, VOLUME 3: ELECTRICAL PROPERTIES OF COAL COMBUSTION PRODUCT Final Report, 15 Oct. 1973 - 31 Dec. 1973
W. E. Young and Joseph Lempert Nov. 1980 60 p refs
(Contract DE-AC01-76ET-10805)
(DE81-026201; DOE/ET-10805/T1-Vol-3; FE-1540-29-Vol-3) Avail: NTIS HC A04/MF A01

Laboratory apparatus was assembled to produce a plasma identical in composition and properties to that resulting in an MHD system when coal and air are burned. This was accomplished with a combustion chamber in which benzene, char, sulfur, and seed mixtures were burned with electrically preheated air. The plasma entered a measuring section where temperatures were measured with iridium versus iridium-rhodium thermocouples, with pyrometers, and by means of line reversal. Measurements of electrical conductivity were made with current and voltage probes. Many difficulties were experienced in the operation and calibration of the equipment, however, some readings were obtained in the 19000 C to 20000 C range, averaging 10 to 20 mhos/meter - much higher than predicted theoretically, probably due to electrical leakage. Electrical measurements were made on the Waltz Mill passage during operation. Readings less than 1.0 mhos/meter were obtained which was not unexpected because the plasma temperature approximated 21000 C. DOE

N81-33061# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 4: DEVELOPMENT AND EVALUATION OF MATERIALS FOR MHD CHANNELS Final Report, 15 Oct. 1973 - 31 Dec. 1975
William E. Young and Barry R. Rossing Nov. 1980 69 p refs
(Contract DE-AC01-76ET-10805)
(DE81-026200; DOE/ET-10805/T1-Vol-4; FE-1540-29-Vol-4)
Avail: NTIS HC A04/MF A01

A small materials test facility is described for simulating hot wall MHD channel operation with 90% coal slag removal. It was concluded that a graded CeO2-ZrO2 composition offered a good possibility for a satisfactorily MHD electrode with a hot face surface temperature of 16000 C and a back face (platinized) temperature of 10000 C. It was also concluded that a larger materials tester with a rectangular cross section and provision for passing current through the electrodes would be desirable. Such an apparatus was built for a follow-on contract. DOE

N81-33062# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 5: COMBUSTION TECHNOLOGY, A REVIEW FOR DEVELOPMENT OF COAL BURNING EQUIPMENT FOR ADVANCED ENERGY CONVERSION SYSTEMS Final Report, 15 Oct. 1979 - 31 Dec. 1975
William E. Young and James A. Dilmore Nov. 1980 72 p refs
(Contract DE-AC01-76ET-10805)
(DE81-026199; DOE/ET-10805/T1-Vol-5; FE-1540-29-Vol-5)
Avail: NTIS HC A04/MF A01

The need to develop a line of combustors capable of burning coal or coal related fuels for a variety of applications associated with advanced power generating equipment was identified. Also required are coal preparation, handling, and feeding equipment necessary for operating the facility, as well as the completely instrumented test stand needed for evaluation and development. This facility, if constructed with government funds, could be made available to other contractors for evaluation and development. The design of a complete coal handling processing and feeding system for a coal combustor is described. Also, designs for two stage combustors for the ETF-1, ETF-2, and ETF-3 are given. DOE

N81-33063# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 6: COOPERATIVE EFFORT IN THE SOVIET U-02 MATERIALS TESTING FACILITY Final Report, 15 Oct. 1973 - 31 Dec. 1975
William E. Young and Edward W. Frantti Nov. 1980 453 p refs
(Contract DE-AC02-76ET-10815)
(DE81-026198; DOE/ET-10805/T1-Vol-6; FE-1540-29-Vol-6)
Avail: NTIS HC A20/MF A01

Five zirconia based materials and the cathode and anode electrode wall modules supplied by the U.S. were tested under MHD operating conditions. The materials were 88ZrO2-12YiO3, 82ZrO2-18CeO2, 50ZrO2-50CeO2, 25ZrO2-75CeO2 and 20ZrO2-78CeO2-2Ta2O5. Each of the five electrode materials had four different current densities established between the anode and cathode during the experiment which lasted a total of 127 hours; 100 hours under MHD power operational conditions. All except six electrode pairs performed satisfactorily during the entire test. These were the pairs which were designated to carry maximum or near maximum current density. Five pairs failed early in the life test and the sixth pair failed in the last several hours. Failure was not due to the electrode materials, however, but due to lead out melting described and the opeational parameters are given U-02 facility is fully described and the operational parameters are given for each phase of the test. The electrode and insulating walls are described and the appropriate parameters that are used to predict the performance of the module are given. DOE

N81-33064# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. Geothermal Programs Office.
CONDENSING CURVES FOR A NUMBER OF MIXED HYDROCARBON WORKING FLUIDS
O. J. Denmuth Jul. 1981 37 p refs
(Contract DE-AC07-76ID-01570)
(DE81-028654; EGG-GTH-5456) Avail: NTIS
HC A03/MF A01

Condensing curves are presented for a number of two-component mixed hydrocarbon working fluids which are potentially usable in binary geothermal cycles. Performance of geothermal thermodynamic cycles incorporating these fluids were evaluated. Two figures summarizing the results of those evaluations are included. Heat rejection systems for advanced geothermal electric power plants utilizing mixed hydrocarbon working fluids are discussed in relation to the data. DOE

N81-33089# Jacobson (Daniel), Inc., Indianapolis, Ind.
HEAVY-DUTY ENGINES ANALYSIS, STUDY 3: APPLICATIONS OF GAS TURBINE ENGINES FOR HEAVY DUTY TRUCKS
D. H. Jacobson Jul. 1981 49 p refs Prepared for Argonne National Lab.
(Contract W-31-109-eng-38)
(DE81-028494; ANL/CNSV-TM-75) Avail: NTIS
HC A03/MF A01

The operational acceptance, technical feasibility, economic viability, and benefits of introducing gas turbine power systems into commercial trucking operations was studied. The scope of the total program and the key elements and steps required to conduct an effective demonstration to production evaluation program are developed. The turbine engines available for near term installation in representative vehicles, including the development status, projected performance, delivery schedule, and cost estimates. The impact of technological advancement in the areas of ceramics, controls, transmissions and heat exchangers is also a factor in the projection of the full potential that is realized by the advanced propulsion system. DOE

N81-33171# Sandia Labs., Albuquerque, N. Mex.
AERODYNAMIC SIZING OF VERTICAL-AXIS WIND TURBINES FOR WIND FARMS
James K. Cole Aug. 1981 30 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029294; SAND-81-0979) Avail: NTIS
HC A03/MF A01

This study addresses the issue of whether a large number of small turbines or a small number of large turbines will generate the most total power on a given wind farm. The effects of atmospheric boundary layer, turbine pedestal height, and turbine Reynolds number are evaluated for vertical-axis wind turbines (VAWTs) that are 17, 46, and 85 m in diameter. Results indicate that for realistic thicknesses of atmospheric boundary layers, increasing the size of the turbine increases the total power generated. Adding a pedestal may also increase the power generated. If the atmospheric boundary layer exceeds 100 m in thickness, a wind farm can generate up to 73% more power through the use of 85-m-dia VAWTs instead of 17-m-dia VAWTs. DOE

N81-33436# South Carolina Energy Research Inst., Columbia.
RESIDUAL-ENERGY-APPLICATIONS PROGRAM; SUPPORT AND INTEGRATION REPORT
F. J. McCrosson Nov. 1980 94 p refs
(Contract DE-AC09-77ET-12866)
(DE81-025479; DOE/ET-12866/6) Avail: NTIS
HC A05/MF A01

The proposed government-owned EAST Facility at the Savannah River Plant in Aiken, South Carolina, would provide capabilities for development and confidence testing of industrial heat pumps, high temperature bottoming cycles, low temperature Rankine cycle power generation systems, and absorption chillers. This report describes support and integration activities that were performed during the contract year. The various elements that impact on the EAST Facility are discussed and an assessment of the EAST Facility mission is given. The report concludes with proposed milestones, schedule, and costs for design, construction, and operation of the facility. DOE

N81-33443# Science Applications, Inc., La Jolla, Calif.
USER'S MANUAL FOR THE DOEHPE (DOE HEAT PUMP EFFICIENCY) COMPUTER CODE
13 Aug. 1980 18 p refs
(Contract DE-AC03-79CS-10757)
(DE81-021562; SAI-444-80-479-LJ) Avail: NTIS HC A02/MF A01

The computer code used to generate air source heat pump seasonal and annual performance factors is documented. These factors as well as annual energy consumption for each of the six climatic regions in the US are calculated. The standard measurements of heat pump capacities, power inputs and heat pump description data are used as input data. The system description data is used to differentiate between single speed and dual speed compressors, as well as to account for different degradation coefficients, modes of operation (cooling and heating, or heating only), and defrosting systems (demand or time temperature control). For dual speed compressor models, the code differentiates between compressors which cycle on and off at high speed and compressors which alternate between low and high speeds to meet the building heating or cooling loads. DOEHPE also accomodates heat pump systems that do not have an air circulation fan on the indoor coil as part of the system. DOE

N81-33490# General Electric Co., Schanectady, N. Y. Gas Turbine Div.
DEVELOPMENT OF HIGH-TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO A TECHNOLOGY READINESS STATUS PHASE 2 Quarterly Report, Apr. - Jun. 1981
M. W. Horner Jul. 1981 62 p refs
(Contracts DE-AC01-76ET-10340; EX-76-C-01-1806)
(DE81-025444; DOE/ET-10340/111) Avail: NTIS HC A04/MF A01

A technology readiness vehicle (TRV) to demonstrate the performance of a combined cycle power plant with high temperature gas turbines using coal derived gas fuel was developed. Two major development tests were completed. The first stage composite nozzles were successfully cycled for a total of 617 thermal cycles. In the second test the sectoral combustor was fired first on a propane/steam mixture and then on a synthetic low-Btu (LBtu) gas. The combustor was tested on: the cold and fired flow tests over the operating range, the determination of the effect of varying primary/secondary fuel flow splits, the effects of fuel composition with varying propane/steam ratios, and the determination of the minimum operating (blow out limits) map. Modification of the rotor water delivery and distribution test rig was completed to provide a more positive locking attachment of the water commutator shaft to the test turbine wheel. DOE

N81-33492*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RELIABILITY AND QUALITY ASSURANCE ON THE MOD 2 WIND SYSTEM
W. E. B. Mason and B. G. Jones (Boding Engineering and Construction Co., Seattle, Wash.) 1981 16 p refs Presented at 5th Biennial Wind Energy Conf. and Workshop, Washington, 5-7 Oct. 1981; sponsored by Solar Energy Res. Inst. and DOE
(Contract DE-AI01-79ET-20305)
(NASA-TM-82717; DOE/NASA/20305-6; E-1015) Avail: NTIS HC A02/MF A01 CSCL 14D

The Safety, Reliability, and Quality Assurance (R&QA) approach developed for the largest wind turbine generator, the Mod 2, is described. The R&QA approach assures that the machine is not hazardous to the public or to the operating personnel, is operated unattended on a utility grid, demonstrates reliable operation, and helps establish the quality assurance and maintainability requirements for future wind turbine projects. The significant guideline consisted of a failure modes and effects analysis (FMEA) during the design phase, hardware inspections during parts fabrication, and three simple documents to control activities during machine construction and operation. E.A.K.

N81-33602*# Lockheed Missiles and Space Co., Huntsville, Ala.
WIND FLOW CHARACTERISTICS IN THE WAKES OF LARGE WIND TURBINES. VOLUME 1: ANALYTICAL MODEL DEVELOPMENT
W. R. Eberle Sep. 1981 217 p refs
(Contracts DEN3-29; EX-76-I-01-1028)
(NASA-CR-165380; DOE/NASA/0029-1; LMSC-LOREC-D000008-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 10A

A computer program to calculate the wake downwind of a wind turbine was developed. Turbine wake characteristics are useful for determining optimum arrays for wind turbine farms. The analytical model is based on the characteristics of a turbulent coflowing jet with modification for the effects of atmospheric turbulence. The program calculates overall wake characteristics, wind profiles, and power recovery for a wind turbine directly in the wake of another turbine, as functions of distance downwind of the turbine. The calculation procedure is described in detail, and sample results are presented to illustrate the general behavior of the wake and the effects of principal input parameters. T.M.

N81-33616*# Tennessee Technological Univ., Cookeville. Dept. of Mechanical Engineering.
EVALUATION OF A WIND TURBINE ELECTRIC POWER GENERATOR Final Report, 1 Jun. 1980 - 15 Sep. 1981
William B. Swim 15 Oct. 1981 180 p
(Grant NAG8-007)
(NASA-CR-164879) Avail: NTIS HC A09/MF A01 CSCL 10A

A technical assessment of the aerodynamic performance of the wind wheel turbine (WWT) is reported. The potential of the WWT in utilizing wind as an alternate power source was evaluated. Scaling parameters were developed to predict the aerodynamic performance of WWT prototype sized to produce 3, 9, 30, and 100 kw outputs in a 6.7 m/sec wind T.M.

N81-33619# Argonne National Lab., Ill.
TECHNICAL SUPPORT FOR OPEN-CYCLE MHD PROGRAM Progress Report, Jul. - Sep. 1979
G. F. Berry, ed. Jun. 1981 123 p refs
(Contract W-31-109-eng-38)
(DE81-027564; ANL/MHD-80-2) Avail: NTIS HC A06/MF A01

The support program for open cycle MHD which consists of developing the analytical tools needed for investigation of the performance of the major components in the combined cycle MHD/steam power system is described. The primary components of the systems, unique to MHD, and the integration of these analytical models into a mode for the entire power producing system are examined. The project includes modeling of the secondary combustor, generator, seed deposition, and formation and decomposition of NO. Costing models were developed to assess the effect of parameter changes on cost of electricity. Parametric studies are performed to evaluate the performance of the U-25B generator and to support the design of the US U-25B generator. DOE

N81-33621# Midwest Research Inst., Golden, Colo Solar Energy Research Inst.
ADVANCES IN THE SERI-DOE ELECTROCHEMICAL PHOTOVOLTAIC CELL PROGRAM
W. Wallace, Rommel Noufi, and Satyen Deb May 1981 8 p refs Presented at the IEEE PV Specialists Conf., Orlando, Fla., 12-15 May 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-025908; SERI/TP-613-1224; CONF-810526-34) Avail: NTIS HC A02/MF A01

The electrochemical photovoltaic cell program to evaluate the photovoltaic energy conversion efficiency, stability and storage potential of amorphous and polycrystalline semiconductor/electrolyte systems is described. Technologies capable of the conversion of light energy into electrical energy either directly in regenerative electrochemical photovoltaic devices or indirectly in overall regenerative cyclic systems incorporating storage are described. The goal of the program is to develop and demonstrate the viability of low cost electrochemical photovoltaic cells competitive with solid state photovoltaic devices and photoelectrochemical storage systems competitive with battery connected photovoltaic array storage. DOE

N81-33625# Midwest Research Inst., Golden, Colo. Developing Countries Branch.
WIND POWER FOR DEVELOPING NATIONS
Amir S. Mikhail Jul. 1981 331 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE81-025792; SERI/TR-762-966) Avail: NTIS HC A15/MF A01

The global potential of wind energy conversion systems (WECS) was assessed. The cost effectiveness of WECS depends on the availability of the wind resource, system power performance, and the comparative cost of alternative energy sources. An overview of the global wind resource including observed zonal wind systems for each continent, available wind data, current wind maps, and ongoing studies to assess the global wind potential are presented. A methodology to obtain a match between machine and site characteristics for most cost effective power production is outlined. DOE

N81-33637# Aerodyne Research, Inc., Bedford, Mass. Center for Chemical and Environmental Physics.

CHARACTERIZATION OF OPEN-CYCLE COAL-FIRED MHD GENERATORS Quarterly Technical Progress Report, 1 Feb. - 31 Jul. 1980

J. Wormhoudt, V. Yousefian, M. Weinberg, C. Kolb, M. Martinez-Sanchez, W. Cheng, F. Bien, D. Dvore, W. Unkel, and G. Stewart Sep. 1980 64 p refs

(Contracts EX-76-C-01-2478; DE-AC01-76ET-10775)

(DOE/ET-10775/T1; QR-14; QR-15) Avail: NTIS HC A04/MF A01

The successful design of full-scale, open-cycle, coal-fired MHD generators for baseload electrical production requires a detailed understanding of the plasma chemical and plasma dynamic characteristics of anticipated combustor and channel fluids. Progress in efforts to model the efficiency of an open-cycle, coal-fired MHD channel based on the characterization of the channel flow as well as laboratory experiments to validate the modeling effort is detailed. In addition, studies related to understanding arcing phenomena in the vicinity of an anode are reported. DOE

N81-33638# Thermo Electron Corp., Waltham, Mass.

DOE ADVANCED THERMIONIC TECHNOLOGY PROGRAM Progress Report, Jan. - Mar. 1981

1981 58 p refs

(Contract DE-AC02-81ET-11291)

(DE81-027307; TE-4258-247-81; PR-46) Avail: NTIS HC A04/MF A01

Progress over a 3 month period in thermionic performance is reported. Significant accomplishments included: (1) continuing stable output from the combustion test of the one inch diameter hemispherical silicon carbide diode at an emitter temperature of 1730 K for a period of over 6400 hours; (2) demonstration of an additive oxygen effect in a research diode with a cesium graphite reservoir located in the collector; (3) preliminary testing of the four diode module; and (4) evaluation of a research diode with ZrO2-Mo cermet electrodes. DOE

N81-33646# Hawaii Univ., Honolulu. Natural Energy Inst.

SOLAR TECHNOLOGY ASSESSMENT PROJECT. VOLUME 7: A REVIEW OF OTEC

Paul C. Yuen Apr. 1981 150 p refs Prepared in cooperation with Florida Solar Energy Center, Cape Canaveral 12 Vol.

(Contract DE-FC02-79CS-30278)

(DE81-029006; DOE/CS-30278/T6-Vol-7) Avail: NTIS HC A07/MF A01

The Ocean Thermal Energy Conversion (OTEC) principle is discussed along with general system and cycle types, specific OTEC designs, applications, and the ocean thermal resource. The historic development and present status of OTEC are reviewed. Power system components of the more technically advanced closed-cycle OTEC concept are discussed: heat exchangers, corrosion and biofouling countermeasures, working fluids, ammonia power systems, and on-platform seawater systems. Several open-cycle features are also discussed. A critical review of the ocean engineering aspects of the OTEC power system is presented. Major subsystems such as platform, cold water pipe, mooring system, dynamic positioning system and power transmission cable system are assessed for their relationships with the ocean environment and with each other. Nine available studies of OTEC costs are reviewed, and tentative comparisons are made between OTEC and traditional fuel costs. Environmental and social effects of OTEC development and international and national laws regulating OTEC plants are reviewed. DOE

N81-33667# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany). Neue Technologie.

FINAL PLANS FOR THE CONSTRUCTION OF GROWIAN Final Report

Friedrich Koerber Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 89 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-171; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18,50

A large scale wind energy converter, GROWIAN, with an installed electrical power of 3 MW was designed. The horizontal axis wind turbine employs a two blade rotor with teetered hub in downwind position. Electricity produced is fed directly into the grid. Power regulation is provided by electrically activated pitch variation. A planetary gear transfers rotation to a variable speed generator with a frequency controlled output to the grid. The nacelle and rotor are mounted on the ground and lifted on top of the tower by an internal hoist. Author (ESA)

N81-34027# Mississippi State Univ., Mississippi State. MHD Energy Center.

DIAGNOSTIC INSTRUMENTATION FOR THE UNITED STATES MAGNETOHYDRODYNAMIC/HEAT RECOVERY SEED RECOVERY DEVELOPMENT PROGRAM

David L. Murphree 1981 78 p refs Presented at the MHD/HRSR Scientists and Engr. of the People's Republic of China, 10-31 Jul. 1981

(Contract DE-AC02-80ET-15601)

(DE81-029944; DOE/ET-15601/T4) Avail: NTIS HC A05/MF A01

The diagnostic development program in direct support of the major magnetohydrodynamic/heat recovery seed recovery test facilities is described. These optical diagnostic systems are designed to characterize the internal operating environment of the MHD/HRSR components through non-intrusive, real-time, on-line analysis. The present stage of development of each instrument is discussed. A performance evaluation of these packaged, microprocessor-controlled, optical diagnostic systems is presented in relation to their field-operation. DOE

N81-34031# Westinghouse Electric Corp., East Pittsburgh, Pa. Fusion Power Systems Dept.

CONCEPTUAL DESIGN OF A COMMERCIAL TOKAMAK HYBRID REACTOR (CTHR) Final Report

Dec. 1980 286 p refs

(Contract DE-AC02-77ET-52043)

(DE81-028375; WFPS-TMS-80-012) Avail: NTIS HC A13/MF A01

This design was developed as a first generation commercial plant for the production of fissile fuel to support a significant number of client light water reactor (LWR) plants. The study was carried out in sufficient depth of indicate no insurmountable technical problems exist, assuming the physics of the fusion driver is verified, and has provided a basis for deriving cost estimates of the hybrid plant as well as estimates of the hybrid/LWR symbiotic system busbar electricity costs. This energy system has the potential to be optimized such that the net cost of electricity becomes competitive with conventional LWR plants as the price of U3O8 exceeds $100 per pound. DOE

N81-34034# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.

MHD-GENERATOR ELECTRODE DEVELOPMENT Quarterly Report, Jan. - 31 Mar. 1981

Frank D. Retallick, Laurence H. Cadoff, Donald L. Dietrick, James A. Dilmore, Edsel W. Frantti, Edgar L. Kochka, Jack A. Kuszyk, S. K. Lau, Joseph Lempert, and I. Lloyd Jun. 1981 80 p refs

(Contract DE-AC01-79ET-15529)

(DE81-028538; DOE/ET-15529/T2) Avail: NTIS HC A05/MF A01

The development of cold metallic electrodes which are alternatives to the continued use of platinum as an anode clad material is discussed. Results of laboratory screening tests are presented for materials previously tested and for other available commercial alloys. Results of anode arc tests are compared to observations from electrodes tested in an MHD generator. Laboratory electrochemical corrosion testing was conducted at

two temperatures in molten salts. Initial results from these tests are reported and analyzed. Fabrication of two commerical alloys with 7% platinum included was accomplished and electrochemical testing performed. A superior high temperature performance was noted. WESTF facility checkout and activation operations have been completed and fabrication of the base copper electrode test section is reported. Engineering and test planning activities in support of WESTF tests are reported. DOE

N81-34035# Argonne National Lab., Ill.
STARFIRE: A CONCEPTUAL DESIGN OF A COMMERCIAL TOKAMAK POWER PLANT
M. A. Abdou, C. C. Baker, D. DeFreece (McDonnell Douglas Astronautics Co., St. Louis), C. Trachsel (McDonnell Douglas Astronautics Co., St. Louis), D. Graumann (General Atomic Co.), and J. Kokoszenski (Ralph M. Parsons Co.) 1980 17 p refs Presented at the 8th Intern. Conf. on Plasma Phys. and Controlled Nuclear Fusion Research, Brussels, 1-10 Jul. 1980
(Contract W-31-109-eng-38)
(DE81-023528; CONF-800707-26; IAEA-CN-39/E-1) Avail: NTIS HC A02/MF A01

STARFIRE is a conceptual design for a commercial Tokamak power plant based on the deuterium/tritium/lithium fuel cycle. The emphasis of the study is on the simplicity of the engineering design, maintainability, lower electricity cost, and improved safety and environmental features. The reactor has a 7-m major radius and produces 1200 MW of electric power. STARFIRE operates in a steady-state mode with the plasma current driven by a lower hybrid RF system. The plasma purity control and exhaust system is based on the limiter/vacuum concept, which offers unique advantages for commercial power rectors. The blanket utilizes a solid lithium compound for tritium breeding and pressurized water as the coolant. DOE

N81-34103# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
CHARACTERISTICS OF AN NH3-AIR FUEL CELL SYSTEM FOR VEHICULAR APPLICATIONS
Philip N. Ross, Jr. May 1981 9 p refs Presented at the 16th ASME Intersoc. Energy Conversion Eng. Conf., Atlanta, 9-14 Aug. 1981
(Contract W-7405-eng-48)
(DE81-023245; LBL-12754; CONF-810812-20) Avail: NTIS HC A02/MF A01

The use of hydrogen air alkaline fuel cell in a consumer vehicle application is examined. An indirect ammonia-air fuel cell system is described. The advantages of the alkaline fuel cell system relative to any acid fuel cell are higher power density (factor of 2 to 3) and lower cost components (factor of 2) resulting in significantly lower total cost (factor of 4 to 6). Laboratory scale examinations of the liquid anhydrous ammonia cracking reaction and the power characteristics of an alkaline fuel cell running on cracked ammonia and air were performed. Single cell testing indicated system thermal efficiencies of 34 to 44% can be achieved at power densities of 2600-1000 W/sq m using currently known electrode technology. DOE

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ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission.

A81-41344 Energy transport (Energietransport). K. Düring (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Brennstoff-Wärme-Kraft*, vol. 33, Apr. 1981, p. 156-161. 54 refs. In German.

The estimated investment requirements for the energy economy in West Germany are in the range from 365 to 430 billion DM in the next decade. Approximately 20 to 25% of this value are needed for energy transportation. A part of this sum is to be spent for the transport of coal or the further development of the means of transportation for this transport. Attention is given to questions of international energy transport, the transport of mineral oil, the transport of natural gas, details of coal transportation, the transport of electric energy, and the transport of heat energy over distances of 40 or 50 km. G.R.

A81-44297 # Equipment for studying the heat and mass transfer in capillary channels of a heat-pipe evaporator (Stend dlia issledovaniia teplo- i massoperenosa v kapilliarnykh kanalakh model'noi zony isparenila teplovoi truby). A. N. Fomenko. *Akademiia Nauk Latviiskoi SSR, Izvestiia, Seriia Fizicheskikh i Tekhnicheskikh Nauk*, no. 3, 1981, p. 56-62. 10 refs. In Russian.

Equipment was constructed in order to study the effect of various factors on the heat and mass transfer process. At specific heat fluxes of less than 40-50 kW/sq m, the wall temperature and hence the temperature of the heat-transfer liquid in the channels are less than the saturation temperature at atmospheric pressure. It is experimentally shown that the geometric parameters of the rectangular capillary channel have a significant influence on the value of the heat loss coefficient. The boiling of the heat transfer liquid, however, exerted no appreciable effect on the heat loss and the stability of the evaporation zone of the heat pipe with a wick in the form of an open rectangular channel. The obtained heat loss coefficient can be used to design a heat pipe with a wick in the form of a rectangular channel. J.F.

A81-44298 # Results of a study of heat and mass transfer in the rectangular capillary channels of a heat-pipe evaporator (Nekotorye rezul'taty issledovaniia teplo- i massoperenosa v priamougol'nykh kapilliarnykh kanalakh zony isparenila teplovoi truby). A. N. Fomenko. *Akademiia Nauk Latviiskoi SSR, Izvestiia, Seriia Fizicheskikh i Tekhnicheskikh Nauk*, no. 3, 1981, p. 63-70. 8 refs. In Russian.

The presence of turbulence in a heat transfer liquid is noted during its evaporation from capillary channels; this process is conditioned by the thermal capillary convection. An analytical model of the heat and mass transfer during evaporation of the heat transfer liquid from the open capillary channels is presented. A general criterial relationship is obtained for calculating the heat loss during evaporation of the heat transfer liquid from the open rectangular capillary channels. This relationship can be used in the design of the heat pipe. J.F.

A81-45824 # Disturbance of the ionosphere by intense microwave beams (Vozmushchenila ionosfery moshchnymi puchkami SVCh radiovoln). N. A. Mitiakov and S. A. Namazov (Nauchno-Issledovatel'skii Radiofizicheskii Institut, Gorki, USSR). *Radiofizika*, vol. 24, no. 6, 1981, p. 666-670. 11 refs. In Russian.

A satellite solar power station is capable of converting solar radiation into a beam of microwaves of a power of 10 to the 10th W at a frequency of 3000 MHz, which can be directed to any region on the earth's surface. Intense microwave radiation gives rise to significant heating of the ionospheric plasma and causes ionospheric disturbances. The results of non-Soviet research in this field are briefly discussed; an estimation of the stimulated thermal scattering of microwaves in the ionosphere is presented, and the possibility of stimulating the expected ionospheric disturbances using a high-power ground-based transmitter is considered. J.F.

A81-46460 Solchem thermochemical power. T. A. Chubb (U.S. Navy, Naval Research Laboratory, Washington, DC). *Sunworld*, vol. 5, May 1981, p. 90, 91. Research supported by the U.S. Department of Energy, Solar Thermal Test Facility Users Association, Solar Energy Research Institute, and U.S. Navy.

The operating principles of the Solchem thermochemical energy transport system are described. The concept, in which a pipe-linked field of parabolic-dish solar concentrators is used to convert a carbon dioxide and methane mixture into hydrogen, carbon monoxide and steam at each receiver-heat exchanger, allows the transfer of heat from the collectors in gaseous form to a central plant. The transfer gases remain relatively cool in the process, with heat energy being produced at the user site by a catalytically induced chemical reaction that re-converts the processed gases into methane and carbon dioxide. In recently conducted tests, energy delivery at 600 C was obtained while feed and return pipes remained at 100 and 160 C, respectively. The use of salt tanks for energy storage and steam generation is also discussed. O.C.

A81-48146 Ammonia thermochemical energy transport in a distributed collector solar thermal power plant. O. M. Williams (Australian National University, Canberra, Australia). *Solar Energy*, vol. 27, no. 3, 1981, p. 205-214. 17 refs.

A thermochemical energy transport system based on ammonia dissociation/synthesis is shown to have potential for reliable cost-effective operation in a distributed collector solar thermal power plant. Liquid ammonia returned to the central plant from a shaded absorber remains inherently separated from the synthesis gas mixture returned from an exposed absorber, enabling the maintenance of a centralized fluid control. Temporal characteristics of the ammonia-based solar thermochemical absorbers are developed by numerical analysis. Sources of energy loss are examined, and it is shown that flow rates to individual absorbers may cover a 12% range of variation without degradation to the overall energy transport efficiency. Operation of the absorber array is examined under conditions of extreme insolation variation due to a scattered cloud cover. The importance of minimizing the absorber thermal capacity is discussed in relation to the available energy required to restore operation after each cloud period. It is shown that the system is relatively immune to large energy losses in this area, compared to the alternative system where both the pipelines and absorbers must be reheated. J.F.

A81-48562 * Laser power beaming for rocket propulsion and airbreathing propulsion. A. Hertzberg (Washington, University, Seattle, WA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, 1980, p. 421-434. 36 refs. Grant No. NAG3-16.

The developing technology of laser power beaming is introduced, and two systems are used as examples of the capabilities of the laser for beamed energy. In the first system, the potential of the laser to power flight systems ranging from hypersonic air-breathing launch vehicles to commercial jet transports is examined. Attention is given to the possibility of an air-breathing propulsion which offers the promise of a global air transportation network independent of kerosene and powered by solar energy. In addition, consideration is given to a new type of rocket propulsion based on the laser's ability to concentrate coherent laser energy to high power densities. Focused laser beams would heat the propellants directly to produce specific impulses approaching ion and MHD rocket levels, and would do so without the burden of a heavy electrical power supply. B.J.

A81-48563 Lasers, microwaves and hybrid schemes for energy beaming - Options and issues. J. D. G. Rather and P. A. Borgo (BDM Corp., McLean, VA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, 1980, p. 436-442.

Several power beaming applications are considered, including beaming power from the earth to space for expanded civilian and space utilization, relaying power over the horizon via a secondary reflector in space, the ground-based solar option, and power generating plants in space. Consideration is given to such issues as technological feasibility, efficiency, cost effectiveness, time of availability, synergistic applications, and the uniqueness of the potential capabilities. B.J.

N81-28689# Institute for Telecommunication Sciences, Boulder, Colo.
EXAMINATION OF SOME HYPOTHETICAL SPS RECTENNA SITE WITHIN THE CONTIGUOUS UNITED STATES OF AMERICA. PART 1: PRECIPITATION EFFECTS ON HYPOTHETICAL SPS SITES IN THE USA. PART 2: POINT-TO-POINT MICROWAVE AND SERVICE MODE COMMUNICATIONS SYSTEMS NEAR FOUR HYPOTHETICAL SPS RECTENNA SITES IN THE CONTINENTAL UNITED STATES
E. J. Dutton and B. D. Warner May 1981 38 p refs
(Contract DE-AC01-80ER-10160)
(DOE/ER-10160/T4) Avail: NTIS HC A03/MF A01

THE EMC (electromagnetic compatibility) problems for the candidate SPS rectenna site in the Mojave Desert of California was studied. The precipitation effects at nine other hypothetical SPS rectenna sites and the licensed transmitter density at four proposed SPS rectenna sites were examined. The results of the precipitation study indicate that the transmission loss will not vary by more than 3% from site to site for the nine sites considered. Results of the licensed transmitter study for four sites support the contention that a strong correlation exists between population density and operational communications systems within a small area (150 Km x 150 Km). DOE

N81-29598# Sandia Labs., Livermore, Calif. Advanced Components Div.
HYDROGEN COMPATIBILITY OF STRUCTURAL MATERIALS FOR ENERGY STORAGE AND TRANSMISSION Final Report
W. R. Hoover, S. L. Robinson, R. E. Stoltz, and J. R. Spingarn May 1981 64 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-8006) Avail: NTIS HC A04/MF A01

An investigation of the transportation, a program which focused on the feasibility of using the natural gas pipeline network for hydrogen gas transmission is summarized. Dynamic and static tests were used: tensile, fracture toughness, and bursts tests of typical pipeline steels and welds, and sustained load tests on a model pipeline. The toughness of pipeline materials in hydrogen is degraded up to 30% and the burst strength of flawed pipes containing hydrogen decreases by 15 to 20%. Hydrogen assisted fatigue crack growth is rapid and there is sustained load cracking in the heat affected zones of welds. Hydrogen may be transported in the natural gas pipeline network, however, the maximum allowable working pressure will have to be decreased. The magnitude of the decrease was a direct bearing on the economic desirability of transporting hydrogen gas through natural gas pipelines. DOE

N81-31633*# Nover Electronics Corp., Barberton, Ohio.
SONIC SIMULATION OF THE SPS POWER BEAM Final Report
James H. Ott and James S. Rice 31 Mar. 1981 106 p refs
(Contract NAS9-16055)
(NASA-CR-161049) Avail: NTIS HC A06/MF A01 CSCL 10A

A Satellite Power System Microwave Transmission Simulator is described. The simulator generates and transmits a beam audible sound energy which is mathematically similar to the microwave beam which would transmit energy to Earth from a Solar Power Satellite. This allows areas such as power beam formation to be studied in a laboratory environment. L.F.M.

N81-31675# Institute for Telecommunication Sciences, Boulder, Colo.
ANALYSIS OF A PHASE-LOCKED LOOP TO SUPPRESS INTERFERENCE FROM A SOLAR POWER SATELLITE
J. R. Juroshek and F. G. Stewart Feb. 1981 24 p refs Sponsored in part by DOE
(PB81-193781; NTIA-Rept-81-63) Avail: NTIS HC A02/MF A01 CSCL 10B

Signal cancellation techniques are particularly suited to interference from the proposed solar-power satellite which would transmit a coherent, CW, microwave, power signal from a geosynchronous satellite. The analysis concludes that a phase-locked loop and associate AGC circuit could be used to generate a replica of the interfering signal which would then be subtracted from the composite signal. It is also concluded that signal suppression of the order of -30 dB should be possible with current technology. A brief analysis of a second-order, type-one, phase-locked loop is presented. GRA

N81-31676# Institute for Telecommunication Sciences, Boulder, Colo.
ANALYSIS OF INTERFERENCE CAUSED BY THE SOLAR POWER SATELLITE TO SATELLITE EARTH TERMINALS
John R. Juroshek Feb. 1981 44 p refs
(Contract DE-A101-80ER-10160)
(PB81-194268; NTIA-Rept-81-64) HC A03/MF A01 CSCL 10B

The solar power satellite (SPS) is a concept for generating electrical power from solar energy via a geosynchronous orbiting satellite. A facility, such as this, would be able to send approximately 5 to 10 gigawatts of power to Earth on a highly focused 2450 MHz microwave beam. The electromagnetic compatibility problems caused by this amount of microwave power transmission are recognized as a critical factor in the implementation of such a system. The potential for interference between SPS and conventional satellite earth terminals was examined. GRA

N81-31677# Institute for Telecommunication Sciences, Boulder, Colo.
ANALYSIS OF INTERFERENCE FROM THE SOLAR POWER SATELLITE TO GENERAL ELECTRONICS SYSTEMS
John R. Juroshek and Francis K. Steele Feb. 1981 38 p refs
(Contract DE-AI06-79RL-10077)
(PB81-194250; NTIA-Rept-81-65) Avail: NTIS HC A03/MF A01 CSCL 10B

The possibility of interference of conventional consumer electronic devices such as TV receivers, AM/FM stereo receivers, electronic calculators, and FM mobile receivers is considered. Also included are estimates of the field intensities that would be required to produce interference in three different types of integrated circuits. The report also examines the potential for interference to medical electronics devices, with specific emphasis on pacemakers and site security devices such as proximity detectors and security TV cameras. GRA

N81-31678# Commerce Dept., Boulder, Colo.
IMPACT OF SATELLITE POWER SYSTEMS ON THE IONOSPHERE Final Summary Report
1980 103 p refs
(Contract DE-AI02-79CH-10003)
(DOE/CH-10003/1) Avail: NTIS HC A06/MF A01

The material presented is directed toward effects in the ionosphere resulting from heating induced by the passage of the SPS microwave beam. Some topics included are: telecommunication system studies in a simulated SPS environment, and theoretical and experimental studies of the physics of ionospheric heating. DOE

N81-32403# Los Alamos Scientific Lab., N. Mex.
Nb3Ge-BASED 1-m POWER-TRANSMISSION CABLE: MATERIAL DEVELOPMENT, CABLE FABRICATION, AND CABLE-PERFORMANCE TESTS Final Report
M. P. Maley, L. R. Newkirk, J. D. Thompson, and F. A. Valencia Jul. 1981 65 p refs Sponsored by Electric Power Research Inst.
(Contract W-7405-eng-36; EPRI Proj. 7855-1-2)
(DE81-026297; EPRI-EL-1948) Avail: NTIS HC A04/MF A01

The fabrication and testing of a 1 m long coaxial cable constructed from 87 m of our Nb3Ge-clad tape short sample measurements indicated that all of this tape exceeded the specification that J/sub c/ (13.8 K) greater than or equal to 1.8 x 10(6) A/cm(2). The cable was wound in the double helix design of the Brookhaven National Laboratory, BNL, power transmission project. AC current tests were performed at BNL where the cable carried the design current amplitude of 6000 A but exhibited ac losses from 7 to 13 K that were 50 to 100 greater than were expected from short sample measurements.

These losses were attributed to a combination of instrumental problems associated with ac loss measurements on 1-m cables of the double helix design, and effects, and possible tape damage. The results of a materials development program aimed at improving the superconducting performance of our Nb3Ge material is also described. DOE

N81-32455# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.

GROUND ENERGY COUPLING

Philip D. Metz 1981 7 p refs Presented at the DOE Heat Pump Contractors Program Integration Meeting, McLean, Va., 2-4 Jun. 1981

(Contract DE-AC02-76CH-00016)

(DE81-024372; BNL-29676; CONF-810672-21) Avail: NTIS HC A02/MF A01

The feasibility of ground coupling for various heat pump systems was investigated. Analytical heat flow models were developed to approximate design ground coupling devices for use in solar heat pump space conditioning systems. A digital computer program called GROCS (GRound Coupled Systems) was written to model 3-dimensional underground heat flow in order to simulate the behavior of ground coupling experiments and to provide performance predictions which have been compared to experimental results. GROCS also has been integrated with TRNSYS. Soil thermal property and ground coupling device experiments are described. Buried tanks, serpentine earth coils in various configurations, lengths and depths, and sealed vertical wells are being investigated. An earth coil used to heat a house without use of resistance heating is described. DOE

N81-32667# Washington Univ., Seattle. Aerospace Lab.

APPLICATIONS OF POWER BEAMING FROM SPACE-BASED NUCLEAR POWER STATIONS

J. R. Powell (Brookhaven National Lab.), T. E. Botts (Brookhaven National Lab.), and Abraham Hertzberg 1981 8 p refs Presented at the IECEC Conf., Atlanta, 9-14 Aug. 1981

(Contract DE-AC02-76CH-00016)

(DE81-025078; BNL-29582; CONF-810812-27) Avail: NTIS HC A02/MF A01

Power beaming was examined using an advanced compact, lightweight Rotating Bed Reactor (RBR). Closed Brayton power conversion efficiencies in the range of 30 to 40% can be achieved with turbines, with reactor exit temperatures on the order of 2000 K and a liquid drop radiator to reject heat at temperatures of approx. 500 K. Higher RBR coolant temperatures are possible, but gains in power conversion efficiency are minimal, due to lower expander efficiency (e.g., a MHD generator). Two power beaming applications were examined - laser beaming to airplanes and microwave beaming to fixed ground receivers. Use of the RBR greatly reduces system weight and cost, as compared to solar power sources. Payback times are a few years at present prices for power and airplane fuel. DOE

N81-33484*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CONTINUOUSLY VARIABLE TRANSMISSION: ASSESSMENT OF APPLICABILITY TO ADVANCE ELECTRIC VEHICLES

Stuart H. Loewenthal and Richard J. Parker 1981 32 p refs Presented at the 4th Electric Vehicle Council Symp., Baltimore, 21-23 Oct. 1981

(Contract DE-AI01-77CS-51044)

(NASA-TM-82700; DOE/NASA/51044-23; E-983) Avail: NTIS HC A03/MF A01 CSCL 13F

A brief historical account of the evolution of continuously variable transmissions (CVT) for automotive use is given. The CVT concepts which are potentially suitable for application with electric and hybrid vehicles are discussed. The arrangement and function of several CVT concepts are cited along with their current developmental status. The results of preliminary design studies conducted on four CVT concepts for use in advanced electric vehicles are discussed. R.C.T.

07
ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

A81-41345 Energy storage (Energiespeicherung). U. Keier (Kraftanlagen AG, Heidelberg, West Germany). *Brennstoff-Wärme-Kraft*, vol. 33, Apr. 1981, p. 161-163. 32 refs. In German.

Developments in the area of energy storage are characterized, with respect to theory and laboratory, by an emergence of novel concepts and technologies for storing electric energy and heat. However, there are no new commercial devices on the market. New storage batteries as basis for a wider introduction of electric cars, and latent heat storage devices, as an aid for solar technology applications, with satisfactory performance standards are not yet commercially available. Devices for the intermediate storage of electric energy for solar electric-energy systems, and for satisfying peak-load current demands in the case of public utility companies are considered. In spite of many promising novel developments, there is yet no practical alternative to the lead-acid storage battery. Attention is given to central heat storage for systems transporting heat energy, small-scale heat storage installations, and large-scale technical energy-storage systems. G.R.

A81-41721 Systems engineering and analysis. B. S. Blanchard and W. J. Fabrycky (Virginia Polytechnic Institute and State University, Blacksburg, VA). Englewood Cliffs, NJ, Prentice Hall, Inc., 1981. 715 p. 166 refs. $28.95.

An introduction to systems is provided and tools for systems analysis are considered, taking into account system definitions and concepts, approaches for bringing systems into being, models in systems analysis, economic analysis techniques, mathematical modeling and optimization, probability and statistics, queuing theory and analysis, and control concepts and techniques. The system design process is discussed along with the design for operational feasibility, systems engineering management, and system design case studies. Attention is given to conceptual design, preliminary system design, detail design and development, system test and evaluation, design for reliability, design for maintainability, design for supportability, design for economic feasibility, communication system design, finite population system design, energy storage system design, and procurement-inventory system design. G.R.

A81-41940 Specific mass energy capacity of disk flywheels produced from composites. G. G. Portnov and V. L. Kulakov (Akademiia Nauk Latviiskoi SSR, Institut Mekhaniki Polimerov, Riga, Latvian SSR). *(Mekhanika Kompozitnykh Materialov*, Sept.-Oct. 1980, p. 887-894.) *Mechanics of Composite Materials*, vol. 16, no. 5, Mar. 1981, p. 605-611. Translation.

In the present paper, a maximum stress criterion is used to determine the maximum mass energy capacity of disk-type flywheels wound of fibers with given strength and deformation characteristics. The range of strength and rigidity parameters for designing flywheels for effective volumetric and mass energy capacity are determined. V.P.

A81-42456 Adding strontium chloride or calcium hydroxide to calcium chloride hexahydrate heat storage material. G. A. Lane (Dow Chemical Co., Midland, MI). *Solar Energy*, vol. 27, 1981, p. 73-75. 9 refs.

Carlsson, Stymne and Wettermark (1979) reported that the incongruent melting CaCl2-6H20 can be made congruent by adding 2 per cent or more of SrCl2-6H20 or Ca(OH)2. The present paper shows these conclusions to be incorrect because the experimental technique yielded low values for the CaCl2-4H20 liquidus curve, and the chemical analyses of the liquid phases were not reported, prompting the conclusion that SrCl2-6H20 and Ca(OH)2 lower the melting point of CaCl2-4H20, and have little effect on CaCl2-6H20. In addition, although small amounts of CaCl2-4H20 could be obtained on each freezing cycle, in practical use the hexahydrate would freeze before any tetrahydrate is nucleated. D.L.G.

A81-42700 The mini-prototype solar energy earth storage system. S. W. Yuan and M. M. Majdi (George Washington University, Washington, DC). *Energy* (UK), vol. 6, July 1981, p. 571-584. 12 refs. Research supported by the RISE, Inc. and Atlantic Research Corp.

A one-tenth scale model of solar energy earth storage (SEES) system was tested under an artificial condition during the first winter season. The earth storage was heated by house hot water heaters and heat was then extracted with a high performance heat exchanger which was exposed to an open air environment under subfreezing temperatures. The results of these preliminary tests show that the thermal performance of the earth storage heat exchanger (polybutylene plastic coils) and the wet soil medium is quite satisfactory. Furthermore, the response rate of the earth storage to a large heat demand over a short-time duration is more than adequate. (Author)

A81-42982 Durability of high-conductivity solid proton conductors - Dodecamolybdophosphoric acid crystals and dodecatungstophosphoric acid crystals. O. Nakamura, I. Ogino, and T. Kodama (Osaka, Government Industrial Research Institute, Ikeda, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 1. Oxford and New York, Pergamon Press, 1981, p. 119-125.

The effects of humidity on the proton conductivity and dehydration of crystals of dodecamolybdophosphoric acid, H3Mo12PO40.29H2O (12-MPA), and dodecatungstophosporic acid, H3W12PO40.29H2O (12-WPA), to be used as solid electrolytes in H2-O2 fuel cells are investigated, and a simple humidity control device for use with the crystals is presented. The electrical conductivity of polycrystalline pellets was measured by observing the voltage response to a current pulse at room temperature and dehydration was measured according to the weight loss of the pellets under various humidities. Dehydration at humidities less than 70% relative humidity for 12-MPA and 80% relative humidity for 12-WPA is observed to lead to corresponding decreases in conductivity as a function of the extent of dehydration. In order to prevent the reduction in conductivity and possible explosion due to contact between H2 and O2 brought on by crystal dehydration, a humidity control device based on a saturated aqueous solution of potassium hydrogen sulfate was used to maintain a humidity of 87% in the box containing the sample. The use of such a device resulted in no decrease in conductivity of dehydration of samples after continuous exposure for 1000 hours. A.L.W.

A81-42908 A new heat storage system using metal hydrides. S. Ono, M. Kawamura, Y. Ishido, E. Akiba (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan), and S. Higano (Mitsubishi Steel Manufacturing Co., Ltd., Tokyo, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 2. Oxford and New York, Pergamon Press, 1981, p. 937-942.

The development of a prototype chemical heat storage system, designed for the accumulation of fairly high temperature (300 - 400 C) waste heat, and called the Hydriding Heat Storage system is presented. Mg2Ni hydride is used as the high temperature heat storing medium, and LaNi5H6 is used as a reservoir for the hydrogen released from the heat storing medium. The system has been in development since 1976, and a 2000 kcal heat capacity prototype system is to be completed by 1982. Basic investigations, i.e., reaction kinetics of absorption and desorption, and heat transfer characteristics of the hydride and/or the metal powder packed bed, are described. K.S.

A81-42971 Thermal storage system using metal hydrides. T. Sakai and N. Honda (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan). In: Hydrogen energy progress; Proceedings of the Third World Hydrogen Energy Conference, Tokyo, Japan, June 23-26, 1980. Volume 4. Oxford and New York, Pergamon Press, 1981, p. 2205-2217. 5 refs.

A chemical thermal energy storage system employing CaNi5 and LaNi5 hydrides is described. Experiments were conducted to determine the performance of the hydrides individually and as elements of the system, and energy balances were estimated. It is shown that the methods described are better suited to long-term

storage than the conventional, chemically non-active ones, and that they are well suited to solar energy systems. O.C.

A81-44148 The lithium-sulphur dioxide cell. I - The porous carbon black cathode. V. Manev, A. Nassalevska, and R. Moshtev (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Elektrokhimichni Iztochnitsi na Tok, Sofia, Bulgaria). *Journal of Power Sources*, vol. 6, Oct. 1981, p. 337-345, 347-356. 23 refs.

Specific capacity of porous carbon cathodes in Li/SO2 cells is assessed as a function of binder content, thickness, rate of discharge, and space distributions. Expressions for determining optimum thickness, length of electrodes, and the maximum capacity are also derived. Specific capacity is found to decrease with an increase in binder content, and increase with a decrease of cathode thickness at low current density. Cathodes thicker than 1 mm had an exponential dependency on the current density, while the pre-exponent was determined by pore volume and molar volume of lithium dithionate. Spatial distribution displayed varying states at high discharge rates, including a transient region, a steady state stage, and a stage of secondary redistribution. Cell capacity dependence on the discharge rate is explained in terms of the relationship between the partial capacities of the components and the current, and good agreement is found between experimental values and those calculated by the derived expressions. D.L.G.

A81-46214 Pressure-temperature-composition relationships for heated drawsalt systems. R. W. Mar and C. M. Kramer (Sandia Laboratories, Albuquerque, NM). *Solar Energy Materials*, vol. 5, June-July 1981, p. 71-79. 15 refs.

A molten nitrate salt mixture consisting of 60% NaNO3 and 40% KNO3 by weight is an attractive candidate for a heat transfer and thermal energy storage fluid in large-power solar systems. The relationships between pressure, temperature and composition (nitrate to nitrite ratio) have been determined for this salt mixture under two system configurations: constant volume (sealed containment) and constant pressure (open containment). For the first, families of pressure-temperature and composition-temperature curves were generated for initial salt volume fractions of 0.1 to 0.7. For the constant pressure system, composition-temperature curves were generated for oxygen pressures of 1, 0.2, 0.01 and 0.001 atm. (Author)

A81-46468 Heat transfer characteristics of the latent heat thermal energy storage capsule. K. Katayama, A. Saito, Y. Utaka, A. Saito, H. Matsui, H. Maekawa, and A. Z. Saifullah (Tokyo Institute of Technology, Tokyo, Japan). *Solar Energy*, vol. 27, no. 2, 1981, p. 91-97. 19 refs.

An analytic and experimental investigation is presented of characteristic heat transfer rate variations to and from a latent heat thermal energy storage capsule filled with a phase change material (naphthalene) and subjected to stepwise variations of the surface temperature. Finite difference calculations based on heat conduction were also carried out to compare with the experimental results. Agreement was found between experimental results and calculated heat flux for the case of the heat removal process, but characteristic trends for the case of heat storage differed due to the effects of natural convection. O.C.

A81-47255 Study of energy storage for long time using chemical reactions. N. Yoneda, S. Ito, and S. Hagiwara (Tokyo Science University, Noda, Japan). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 648-657. 12 refs.

A chemical heat pump system for solar heat storage was studied by using the de-ammoniation and ammoniation of the ammoniated salts NiCl2.6NH3 and CaCl2.8NH3. Heat energy was absorbed by the decomposition of NiCl2.6NH3 at a temperature of 200 C, and the dissociated NH3 reacted with CaCl2.4NH3 to form CaCl2.8NH3 at 0 C. The energy was recovered by the reverse process, and the decomposition and ammoniation of the salts were examined. Based on the results, experiments were performed using a prototype system and mini-pilot plant system, which exhibited only a 90% efficiency due to the large heat capacity of the vessel. A table of dissociation temperatures and energies of some ammoniated salts, and schematic arrangements of the prototype and pilot plant systems are also presented, and it is concluded that the chemical heat pump system can work as a heat storage system for a long time, and can increase the heat storage efficiency up to 15% with a reduction of the heat capacity of the vessel. D.L.G.

A81-47256 Experimental characterization of the thermal performance of a heat-of-fusion storage unit. B. Carlsson, A. Schmidt, A. Gyorki, H. Stymne, and G. Wettermark (Tekniska Hogskolan, Stockholm, Sweden). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 658-665. 9 refs. Research supported by the Statens Rad for Byggnadsforskning.

Experimentally determined thermal performance data are presented for a heat-of-fusion storage unit based on 200 kg of calcium chloride hexahydrate. Constructed as a tube heat exchanger, the unit has a storage medium encapsulated in vertical tubes. Conditions are chosen for their relevance to the application of short-term storage of solar heat, and the heat-of-fusion storage unit is discussed in relation to sensible heat storage in water. Heat transfer rates are calculated according to experimental results and known empirical relations for the heat-transfer coefficients, and good agreement between a theoretically calculated heat of fusion and thermal characteristics of the unit during charging suggest that the method can also be efficient for dimensioning heat-of-fusion storage units. D.L.G.

A81-47257 Thermal energy storage using heat of solution. P. Kulisic, J. Vuletin, J. Mastelic, M. Bosanac, and B. Prib (Zagreb, Sveuciliste, Zagreb, Yugoslavia). In: International Solar Forum, 3rd, Hamburg, West Germany, June 24-27, 1980, Reports. Munich, DGS-Sonnenenergie Verlags GmbH, 1980, p. 666-673. 5 refs.

The fact that certain salts dissolve endothermically with the positive coefficient of solubility can be used in storing thermal energy. Thermal energy storage using saturated aqueous solution of KNO3, NaNO3, NH4NO3, and NH2CONH2 is investigated experimentally, and specific heat capacities are determined and compared with calculated values. Heats of solution for saturated solutions are also estimated and are found to be smaller than those for a high degree of dilution. In particular, the saturated solution of KNO3 looks promising, and a mixture of 46% KNO3 and 54% H20 is suggested for a thermal energy storage material. C.R.

A81-47833 Royal Society, Discussion on Prospects for Industrial Electrochemistry, London, England, December 10, 11, 1980. *Royal Society (London), Philosophical Transactions, Series A*, vol. 302, no. 1468, Sept. 2, 1981. 169 p.

Among the topics dicussed are electrode kinetics, organic reactions via electrochemically generated intermediaries, speculations on industrial electrochemistry, classically modified electrodes for electrocatalysis, and bioelectrocatalysis. Also covered are industrially useful electrochemical cell designs and meaningful optimization procedures, the industrialization of electrochemical reations, electrochemistry in the service of engineering, pulse voltametric methods of analysis, and on-line sensors in industrial water analysis. Attention is in addition given to sodium-sulphur batteries, the nickel-zinc battery for electric vehicles, and novel materials for advanced batteries. O.C.

A81-47834 The sodium-sulphur battery. I. W. Jones (Chloride Silent Power, Ltd., Runcorn, Ches., England). *(Royal Society, Discussion on Prospects for Industrial Electrochemistry, London, England, Dec. 10, 11, 1980.) Royal Society (London), Philosophical Transactions, Series A*, vol. 302, no. 1468, Sept. 2, 1981, p. 339-350.

The sodium-sulphur battery is considered as a candidate for electric vehicle and bulk storage applications markets estimated to exceed one billion pounds sterling globally by the turn of the century. The sodium-sulphur device offers five times the energy density of conventional batteries, potential cost reductions due to the use of cheap and readily available construction materials, and operates at the relatively low temperatures of 300-400 C. The cells have a solid electrolyte, made by sintering alumina containing 10% sodium oxide, while the electrodes are liquid at operating temperatures. Ceramic element lives in excess of 1000 cycles have been achieved. Attention is given such design details as the thermal and

physical properties of glass/ceramic seals and current collector materials and structure. O.C.

A81-47835 The nickel-zinc battery for electric vehicles. P. Rowbeck (Lucas Group Services, Ltd., Solihull, West Midlands, England). *(Royal Society, Discussion on Prospects for Industrial Electrochemistry, London, England, Dec. 10, 11, 1980.) Royal Society (London), Philosophical Transactions, Series A*, vol. 302, no. 1468, Sept. 2, 1981, p. 351-358; Discussion, p. 359, 360. 6 refs.

A comparative study is presented on battery systems under consideration for application to electric vehicles. It is shown that: (1) the 70 W h/kg (at the 1 hour rate) gravimetric energy density of the nickel-zinc battery is about 3.5 times better than that of the lead-acid traction battery, and two-thirds that of the sodium-sulfur battery; (2) the nickel-zinc system's sustained power density of 150-200 W/kg is five times better than that of lead-acid traction batteries and twice as good as the sodium-sulfur system; (3) the volumetric energy densities of nickel-zinc and sodium-sulfur batteries is more than twice that of the lead-acid traction device; and (4) the nickel-zinc battery has a flatter discharge profile over its full capacity range than the sodium-sulfur and lithium-sulfur systems. It is concluded that the nickel-zinc device is the most attractive candidate for medium-term electric vehicle applications. O.C.

A81-48980 Increasing the pumping efficiency of a resonant microwave storage cavity. S. V. Baraev and O. P. Korovin (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *(Zhurnal Tekhnicheskoi Fiziki*, vol. 50, Nov. 1980, p. 2465-2467.) *Soviet Physics - Technical Physics*, vol. 25, Nov. 1980, p. 1444, 1445. 6 refs. Translation.

A theoretical analysis shows that it is possible to improve the efficiency of pumping of a microwave-energy accumulation system by the use of a resonant accumulator whose coefficient of coupling, beta, with the transmission line significantly exceeds unity. It is found that for beta = 10 the maximum efficiency of pumping is 0.75; for beta = 100, the maximum efficiency attains the limiting value of 0.82. The accumulation time corresponding to the maximum pumping efficiency is of the order of 0.001-0.1 sec, and a pulse power increase of 50-75 dB is attained compared to pumping oscillator power. P.T.H.

A81-49281 Nickel-hydrogen battery technology - Development and status. J. D. Dunlop and J. F. Stockel (COMSAT Laboratories, Clarksburg, MD). *COMSAT Technical Review*, vol. 10, Fall 1980, p. 281-297. 6 refs. Research sponsored by the International Telecommunications Satellite Organization.

The current status of aerospace Ni-H2 battery technology is reviewed. Several different Ni-H2 batteries, including a 50-Ah battery and a high-pressure 50-Ah battery, are compared with respect to energy density, energy per unit volume, structural design, and heat transfer capacity. The maximum energy density achieved is 60-1 Wh/kg for the high-pressure 50-Ah cell. The Ni-H2 batteries planned for use in the next generation of INTELSAT communications satellites should achieve 48-Wh/kg usable energy density as compared with the 39 Wh/kg of INTELSAT V batteries. V.L.

A81-49479 Environmental testing of SPE fuel cell assemblies. O. Adlhart (Englehard Minerals and Chemicals Corp., Edison, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 1-3. Grant No. DAAK70-77-C-0222.

Solid polymer electrolyte (SPE) fuel cells can be operated at low ambient temperatures. The considered investigation provides an evaluation of SPE fuel cells assemblies over a broad range of ambient conditions. The conducted tests form part of a program which is concerned with the development of SPE devices for power requirements ranging up to a few hundred watts. Attention is given to the test system, the performance objectives, the test results, low temperature tests, and storage characteristics. It was found that at atmospheric pressure, the cell functions at temperatures ranging from slightly above freezing to about 70 C. Above this level, dehydration of currently available membranes has an adverse effect on performance. A critical aspect of SPE cell operation is the need for maintaining conditions at high relative humidity. G.R.

A81-49487 Shelf life degradation study of a reserve zinc-silver oxide battery. J. J. Lander (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) and T. R. Sowder (USAF, Directorate of Material Management, Hill AFB, UT). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 49-61. 7 refs.

The considered battery is hermetically sealed. It is piston-cylinder actuated by means of a gas generator for electrolyte delivery. The cell block contains 20 cells, and each cell contains 19 plates. The new battery delivers about 11 A-hr to 23 V at an average 164 A. Sample batteries were periodically discharged to establish performance degradation rates. The values of various battery parameters were obtained as a function of age. These parameters include the oxygen content of the positive plates, individual plate and whole cell capacities, positive plate active material resistance, and the resistance of positive active material to the grid. It was found that run time of the zinc plate limits capacity. Failure to meet performance requirements is expected to be limited by capacity, not first pulse voltage. If a linear projection of both descriptors can be made, an average of 38 year battery shelf life is anticipated. G.R.

A81-49497 Lithium/iron sulfide cell development for electric-vehicle propulsion. E. C. Gay, W. E. Miller, V. M. Kolba, and H. Shimotake (Argonne National Laboratory, Argonne, IL). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 173-176. Research sponsored by the U.S. Department of Energy.

The status of a program to develop a lithium/iron sulfide battery for electric vehicle propulsion is reviewed. The cells consist of a lithium-aluminum negative electrode, an FeS positive electrode, and molten LiCl-KCl electrolyte. The melting point of the electrolyte (352 C) requires a cell operating temperature in the range 400-500 C. The cells have met the performance goal of 80 W-hr/kg at the 4 hr discharge rate and 60 W/kg at 50% discharge. The most promising cell designs for high specific energy over long cyclic periods have been identified. V.L.

A81-49499 Development of lithium/metal sulfide secondary batteries for electric vehicle applications. K. Gentry and R. Hudson (Eagle-Picher Industries, Inc., Joplin, MO). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 179-181. 5 refs. Research supported by the U.S. Department of Energy.

Lithium aluminum/metal sulfide cells and batteries have been developed for electric vehicle propulsion. Activities included cell design and development, battery concept design, prototype battery fabrication, and design cost studies for production quantities up to 2000 MW-hr per year. Individual cell performance tests indicated that all goals can be met except for the 200 cycle life goal, and due to high operating temperatures of 430-480 C, an insulated container with high thermal efficiency is required to prevent thermal gradients within the battery. Cost and design studies of the Mark II performance indicate that costs may be in the range of $125/kW-hr when produced in a full-scale production plant, and that the LiAl/MS electrochemical system can be considered a candidate for advanced batteries, and may find a commercial market in the near future. D.L.G.

A81-49503 High energy density rechargeable battery for satellite applications. L. Marcoux (Hughes Aircraft Co., Technology Div., El Segundo, CA) and R. Marsh (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 194-196. Contract No. F33615-79-C-2044.

Several advance battery systems were investigated with reference to their suitability for supporting military space missions with 10-100 kW power requirements. The systems evaluated included: lithium-metal sulfide, sodium-beta alumina-sulfur, redox, zinc-chlorine, and zinc-bromine systems. The redox system was shown to be unsuitable based on the inadequacy of the specific energy. The high-temperature systems LiAl/FeS and Na/S exhibited low specific energies when forced to deliver 100 kW peak power. The aqueous

systems, Zn/Br2 in particular, exhibited a marginal specific energy (60-65 W-hr/kg), but met all other requirements for the low earth orbit applications. V.L.

A81-49504 Rechargeable lithium batteries. H. F. Hunger and J. E. Ellison (U.S. Army, Electronics Technology and Devices Laboratory, Fort Monmouth, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 196-199. 14 refs.

The current status of rechargeable lithium batteries and their potential capabilities are reviewed. Approaches to the optimization of rate capability and cycle life which consider cathode structure, electrolyte characteristics, and electrolyte-electrode chemistry are examined. Technical guidelines are presented for the development of an electrically rechargeable lithium battery for military use with a nominal voltage of 24 V, a nominal capacity of 11 A-hr, and an operating capability over the temperature range from -40 to 71 C. Consideration is also given to molybdenum trioxide electrodes and rechargeable compounds. V.L.

A81-49505 Ambient temperature secondary Li/FeS2 cells. G. H. Newman and L. P. Klemann (Exxon Corporate Research Laboratories, Linden, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 201-205. 10 refs.

The natural pyrite mineral FeS2 is found to be at least a partially rechargeable cathode material. The study demonstrates 22 deep cycles in cells with 'practical' cathode capacity densities. The long-term rechargeability shown in high-temperature cells is considered to suggest the high cycle life and secondary properties of FeS2. The results establish the technical possibility of applying FeS2 as a high rate cathode material in primary lithium cells which contain lithium organoborate electrolytes. C.R.

A81-49507 Carbon-sulfur compounds as cathodes for lithium high energy secondary cells. C. H. Cheng (Exxon Research and Engineering Co., Linden, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 208-211. 11 refs.

The feasibility of using carbon, a low weight and abundant element, to carry sulfur atoms as a high energy sulfur cathode is demonstrated. The high open-circuit voltages of Li/C(x)S cells suggest that the free energies of formation of the carbon-sulfur compounds are low in comparison with those of other sulfides such that no undue decrease in the cell voltage occurs. The performance of the C(x)S cathode, however, is limited by the discharge current rate in the ambient organic electrolyte system. Preliminary studies suggest that the rate capability of the carbon-sulfur compound is related to the pore structure of the material. C.R.

A81-49510 Evaluation of the pocket plate nickel cadmium cells/battery for military application. J. W. Lear (Martin Marietta Aerospace, Denver, CO). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 222-224.

Test results are presented for a 22-cell 129 A-hr pocket plate nickel cadmium battery designed to power a military communication complex on a twenty-four hour basis (nine hours of discharge followed by fifteen hours of charge). It is shown that, with proper charge control, the battery is capable of operating with minimum overcharges (about 5%) and efficiencies as high as 90-95%; self discharge is approximately 0.1% per day. V.L.

A81-49512 A nickel-hydrogen bipolar secondary battery. R. F. Chireau and A. S. Berchielli (Yardney Electric Corp., Pawcatuck, CT). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 230-236. 26 refs. Research supported by the Yardney Electric Corp.

A study was conducted to test the concept of using bipolar nickel-hydrogen batteries for an energy storage system that would be compatible with both existing and future electrical generation and distribution equipment. The feasibility of a bipolar nickel-hydrogen rechargeable system was investigated with respect to performance characteristics such as charge acceptance, overcharge capability, cell reversal capability, electrolyte management, and cycle life. Peak specific power figures of over 350 W per kilogram were achieved and the specific energy of the bipolar battery was 60 W-hr/kg at the 3 hr rate of discharge. It was concluded that the new energy storage system would be suitable for load-leveling applications. V.L.

A81-49513 High energy density long cycle life nickel-zinc batteries. O. C. Wagner, A. Almerini, and R. L. Smith (U.S. Army, Electronics Technology and Devices Laboratory, Fort Monmouth, NJ). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 237-240.

Results of a nickel-zinc battery research and development program are reported with emphasis on those factors which most influence the battery performance. These factors are: the separator system, the charging mode, additives to the zinc anode, and pressure cutoff controls. It is found that the best separator system consists of two layers of nickel coated Celgard 2500 sandwiched between two layers of uncoated Celgard 3500. The best charging method is an optimized interrupted current mode. The best binary additive tested so far is 1/2% indium hydroxide plus 1% lead oxide. V.L.

A81-49514 Front end nickel-zinc systems for noninterruptible power systems. M. Klein and A. Leo (Energy Research Corp., Danbury, CT). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 244-246. Research supported by the Honeywell Corp. and U.S. Air Force.

Scale-up considerations and performance characteristics of 2000 A-hr Ni-Zn cells are investigated to determine design features for the MX power system. Cell design and construction of the batteries, electrodes, and Co(OH)2, and graphite and Teflon positive plates are discussed. Two 2000 A-hr cells were tested over a thirty week period, charged at 85 A for 48 hr, and discharged at 85 A to 1.30 V. One cell demonstrated excellent capacity retention on float, although the other failed due to dendrite shorting caused by higher current densities obtained as a result of the drying out of the negative plate. Variations in initial performance between the two cells is attributed to variation in the extent of the dryout problem, and limiting factors in the float applications are attributed to separation degradation and electrolyte management. D.L.G.

A81-49515 Status of nickel/zinc and nickel/iron battery technology for electric vehicle applications. N. P. Yao, C. C. Christianson, R. C. Elliott, and J. F. Miller (Argonne National Laboratory, Argonne, IL). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 247-258. 30 refs. Research supported by the U.S. Department of Energy.

Significant progress is reported toward nickel/zinc and nickel/iron battery performance goals necessary for widespread application to electric vehicle systems. Although nickel/zinc module test data have shown a specific energy of nearly 130 W/kg, cycle life improvements beyond the 120-cycle capability demonstrated to date are necessary. Nickel/iron modules have reached a specific energy of nearly 50 W-hr/kg, and a specific power of 100 W/kg, with lives of 300 cycles and energy efficiency improvements from 50 to 65%. The 1984 performance goals are for a nickel/iron cycle life of 2000 cycles, and a nickel/zinc life of 800 cycles, with a price for both systems of $70/kWh, assuming a production level of 100,000 25 kWh units per year. O.C.

A81-49518 Improved lead-acid batteries - The promising candidate for near-term electric vehicles. N. P. Yao, C. C. Christianson, and T. S. Lee (Argonne National Laboratory, Argonne, IL). In: Power Sources Conference, 29th, Atlantic City, NJ, June 9-12, 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 261-265. 18 refs. Research sponsored by the U.S. Department of Energy.

The paper describes the status and progress of the electric vehicle lead-acid battery technology that has been under development since 1978 under the auspices of the DOE/Argonne National Laboratory Near-Term Battery Project. Since the initiation of the program, the energy density of the battery has been increased from

25-30 W-hr/kg to over 40 W-hr/kg and the peak power has increased from 70 W/kg to over 110 W/kg (at 50% state of charge). Currently, the emphasis is on the improvement of cycle life of these batteries from the present level of 120-250 cycles to 800 cycles (at 80% depth of discharge). V.L.

A81-49520 **Thermal energy storage by the chemical reaction - Augmentation of heat transfer and thermal decomposition in the CaO/Ca/OH/2 powder.** A. Kanzawa (Tokyo Institute of Technology, Tokyo, Japan) and Y. Arai. *Solar Energy*, vol. 27, no. 4, 1981, p. 289-294. 11 refs.

Thermal storage using thermal decomposition of Ca(OH)2 has been investigated with the objective of finding an efficient heating technique. It is shown that copper plates placed in Ca(OH)2 powder, whose thermal conductivity is poor, act effectively as heat transfer fins. The best results are obtained with plates 5-10 cm high and 0.02 cm thick spaced 0.5-1.0 cm apart. V.L.

A81-49878 **Electric and hybrid vehicles.** Edited by L. J. Jacovides (General Motors Corp., Detroit, MI), E. P. Cornell (General Electric Co., Fairfield, CT), and R. Kirk (U.S. Department of Energy, Washington, DC). Warrendale, PA, Society of Automotive Engineers (Progress in Technology Series, No. 21), 1981. 355 p. $28.

A study of the energy utilization of gasoline and battery-electric powered special purpose vehicles is discussed along with the impact of electric cars on national energy consumption, the development of electric vehicles in Japan, the applicability of safety standards to electric and hybrid-vehicles, and crashworthiness tests on two electric vehicles. Aspects of energy storage are explored, taking into account a review of battery systems for electrically powered vehicles, the dynamic characterization of lead-acid batteries for vehicle applications, nickel-zinc storage batteries as energy sources for electric vehicles, and a high energy tubular battery for a 1800 kg payload electric delivery van. Subjects considered in connection with drive systems include the drive system of the DOE near-term electric vehicle, a high performance AC electric drive system, an electromechanical transmission for hybrid vehicle power trains, and a hybrid vehicle for fuel economy. Questions of vehicle development are examined, giving attention to the Electrovair electric car, special purpose urban cars, the system design of the electric test vehicle, a project for city center transport, and a digital computer program for simulating electric vehicle performance. G.R.

N81-28980# Argonne National Lab., Ill.
DOE'S NEAR-TERM ELECTRIC VEHICLE BATTERY PROGRAM. STATUS OF IMPROVED LEAD-ACID, NICKEL/IRON, AND NICKEL/ZINC BATTERY DEVELOPMENTS
N. P. Yao, C. C. Christianson, R. C. Elliot, T. S. Lee, and J. F. Miller. 1980. 48 p. refs. Presented at the 3d Intern. Elec. Vehicle Exposition and Conf., St. Louis, 20-22 May 1980
(Contract W-31-109-eng-38)
(CONF-800523-4) Avail: NTIS HC A03/MF A01

Significant progress in lead acid, nickel/iron and nickel/zinc battery technology was made towards achieving the technical performance goals necessary for widespread use of these battery systems in electric vehicle applications. The energy density of lead acid eV batteries has advanced from 25 to 30 Wh/kg to over 40 Wh/kg. The prospect for obtaining a lead acid battery having both high energy density and long cycle life in a few years is very promising. Nickel/iron modules demonstrated a specific energy of nearly 50 Wh/kg and a specific power of 100 W/kg, cycle lives of 300 were achieved during early 1980 and testing continues, and the energy efficiency was improved from less than 50 percent to over 65 percent. Nickel/zinc module test data show a specific energy of nearly 70 Wh/kg and a specific power of 130 W/kg. However, cycle life improvements are still needed. Cost reduction continues to receive major emphasis at developers of both nickel/zinc and nickel/iron batteries. DOE

N81-28981# Brookhaven National Lab., Upton, N. Y.
ZIRCONIA FUEL CELLS AND ELECTROLYZERS
H. S. Isaacs. 1980. 28 p. refs. Presented at the 1st Intern. Conf. on the Sci. and Technol. of Zirconia, Cleveland, 18 Jun. 1980
(Contract DE-AC02-76CH-00016)
(BNL-29133; CONF-8006157-1) Avail: NTIS HC A03/MF A01

A review of the historical development, operation, and problems of solid oxide electrolyte fuel cells and electrolyzers is given. The thermodynamic principles of operation are reviewed, and the overvoltage losses during operation of fuel cells and steam electrolyzers are discussed including physical factors and electrochemical factors. DOE

N81-28601# Indian Lead Zinc Information Centre, New Delhi.
SYMPOSIUM ON BATTERY SYSTEMS IN THE 1980'S
Nov. 1980. 85 p. refs. Symp. held at New Delhi, 26 Feb. 1979
(PB81-123689) Avail: NTIS HC A05/MF A01 CSCL 10C

The status of the battery industry in the country is discussed. A realistic assessment of the emerging trends in battery technology is presented. While acknowledged experts in the fields of lead acid batteries from India and abroad presented papers covering comprehensively the different aspects of battery systems, the participants were senior executives, technologists and government officials from user and producer interests. Representing the producer interests were the producers of lead and zinc and battery manufacturers. The symposium afforded an opportunity for not only exchange of information but also for cross-fertilization of ideas. GRA

N81-29532*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INITIAL GUIDELINES AND ESTIMATES FOR A POWER SYSTEM WITH INERTIAL (FLYWHEEL) ENERGY STORAGE
Luther W. Slifer, Jr. Dec. 1980. 11 p
(NASA-TM-82134) Avail: NTIS HC A02/MF A01 CSCL 10C

The starting point for the assessment of a spacecraft power system utilizing inertial (flywheel) energy storage. Both general and specific guidelines are defined for the assessment of a modular flywheel system, operationally similar to but with significantly greater capability than the multimission modular spacecraft (MMS) power system. Goals for the flywheel system are defined in terms of efficiently train estimates and mass estimates for the system components. The inertial storage power system uses a 5 kw-hr flywheel storage component at 50 percent depth of discharge (DOD). It is capable of supporting an average load of 3 kw, including a peak load of 7.5 kw for 10 percent of the duty cycle, in low earth orbit operation. The specific power goal for the system is 10 w/kg, consisting of a 56w/kg (end of life) solar array, a 21.7 w-hr/kg (at 50 percent DOD) flywheel, and 43 w/kg power processing (conditioning, control and distribution). Author

N81-29571# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
APPLIED BATTERY AND ELECTROCHEMICAL RESEARCH PROGRAM REPORT FOR FISCAL YEAR 1980
E. Cairns, DeJongh Lutgard, James Evans, Frank McLarnon, Rolf Muller, John Newman, Phillip Ross, and Charles Tobias. Apr. 1981. 135 p
(Contract W-7405-eng-48)
(LBL-12514) Avail: NTIS HC A06/MF A01

The Exploratory Battery R and D area provides for the study of new electrochemical couples, or of new approaches to known battery systems. High temperature systems investigated include Ca/molten salt/FeS2, Li/Li1-Al2O3/TiS2, and Na/beta "-Al2O3/SC14-NaCl-AlCl3. Ambient temperature systems studied were Li/So2/C and Zn/NaCh/Fe(CN)6. New electrode/electrolyte formulations for Zn/KOH/NiOCH and Li/organic electrolyte/TiS2 cells were investigated, and a status study of ambient temperature secondary lithium batteries was conducted. Projects grouped in the Engineering-Science Research area include morphological and optical studies of battery electrodes in Pb/H2SO4/PbO2, Zn/KOH/NiOOH, and metal/air cells; and a thermal management study of the high temperature Li/molten salt/FeS Battery. DOE

N81-29585# Department of Energy, Washington, D. C. Office of Advanced Conservation Technologies.
PHYSICAL AND CHEMICAL ENERGY STORAGE PROGRAM. PROJECT SUMMARY DATA
Mar. 1981. 47 p
(DOE/CE-0006) Avail: NTIS HC A03/MF A01

The Department of Energy's Office of Advanced Conservation Technologies is developing cost-effective, efficient, reliable, and environmentally acceptable energy storage systems. The mission of the Energy Storage Program is to develop devices, processes, and subsystems which permit domestic energy resources to be

supplied at the time and locations where they can be used. In this program, energy is stored in thermal, chemical, mechanical, and magnetic forms. Generally, the best storage device for a specific supply system is one which minimizes the need for converting from one energy form to another in the overall system which consists of production, storage, transportation, and end-user equipment. This publication consists principally of summary sheets for each active project in the Chemical/Hydrogen, Thermal, Magnetic, Mechanical, Flywheel and Underground Energy Storage Program for FY 1980. DOE

N81-29687# Midwest Research Inst., Kansas City, Mo. Solar Energy Research Inst.
SURVEY OF SENSIBLE AND LATENT HEAT THERMAL ENERGY STORAGE PROJECTS
F. Baylin and M. Merino May 1981 335 p refs
(Contract DE-AC02-77CH-00178)
(SERI/RR-355-456) Avail: NTIS HC A15/MF A01

Ongoing and completed research projects on sensible and latent heat thermal enegy storage for low, intermediate, and high temperature applications are reviewed. Projects in the United States and abroad are included. Several research efforts are in the index although the project descriptions are absent. Project lists are organized into four sections: short term sensible heat storage; seasonal sensible heat storage; latent heat storage; and models, economic analysis, and support studies. The organization of the Department of Energy programs managing many of these projects is also outlined. Projects are presented in a standard format that includes laboratory; funding level and period; status; project description; technical and economic parameters; and applications. DOE

N81-29819# Oak Ridge Y-12 Plant, Tenn. Fabrication Systems Dept.
OAK RIDGE FLYWHEEL EVALUATION LABORATORY TEST REPORT ON THE GARRETT AIRESEARCH FLYWHEEL
R. S. Steele and E. F. Babelay Feb. 1981 93 p refs
(Contract W-7405-eng-26)
(Y/DX-227) Avail: NTIS HC A05/MF A01

The graphite-epoxy-composite spokes began to splinter in four tip locations after the sixth balance run to 200 Hz (12,000 rpm). Testing was continued until a catastrophic failure was achieved. The spoke splintering did not appear to be a factor in the ultimate capability. Maximum stored energy was 1.16 kWh (4.17 MJ) at 74.6 Wh/kg (269 kJ/kg) at 463 rps (27,780 rpm). Ultimate speed was limited by a dynamic instability at 463 rps. Actual failure occurred in a braking mode at 390 rps. Other observations of dynamic behavior included the mass eccentricity shifting repeatably with speed at a rate of 0.051 mm in 170 Hz; this action was attributed to nonuniform flexing of the rim. A permanent balance shift of approximately 0.051 mm occurred, possibly indicating a slippage of the rim relative to the hub. Radiography shows that the rims realigned themselves. DOE

N81-29623# California Univ., Livermore. Lawrence Livermore Lab.
APPLICATION ANALYSIS OF ENERGY-STORAGE SYSTEMS FOR TRANSPORTATION
L. G. OConnell and L. R. Spogen 13 Apr. 1981 19 p refs Presented at Tech. and Economic Analysis Contractors' Meeting, Chicago, 21 Apr. 1981
(Contract W-7405-eng-48)
(UCRL-85851; CONF-810459-2) Avail: NTIS HC A02/MF A01

An analysis study of energy storage systems for automotive propulsion was conducted. The most promising energy storage devices and the vehicular missions for which the resultant propulsion systems are best suited were identified. Preliminary findings concerning an assessment of the impact on energy storage device requirements of current transportation developments and trends are discussed. DOE

N81-30051# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY-STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 2: ENERGY-STORAGE DEVICES Final Report
L. G. OConnell, C. J. Anderson, E. Behrin, W. Cliff (Battelle Northwest Labs., Seattle, Wash.), R. Crisp (Arkansas Univ. Fayetteville), H. C. Forsberg, C. J. Hudson (Interplan Corp.), J. S. Payne, R. Renner (Brookhaven National Lab.), M. D. Schrot et al 15 Dec. 1980 247 p refs 4 Vol.
(Contract W-7405-eng-48)
(UCRL-53053-80-Vol-2) Avail: NTIS HC A11/MF A01

The operating, safety and performance characteristics of specific devices for electrochemical, mechanical, chemical and thermal energy storage are evaluated. The feasibility for use in automobile propulsion systems and the future research required for their use in automobile propulsion systems and the future research required for development of promising devices are addressed. DOE

N81-30052# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY-STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION. VOLUME 3: AUTOMOTIVE PROPULSION SYSTEMS Final Report
L. G. OConnell, C. J. Anderson, E. Behrin, W. Cliff (Battelle Pacific Northwest Labs., Seattle, Wash.), R. Crisp (Arkansas Univ. Fayetteville), H. C. Forsberg, C. L. Hudson (Interplan Corp.), J. S. Payne, R. Renner, M. D. Schrot et al 15 Dec. 1980 372 p refs 4 Vol.
(Contract W-7405-eng-48)
(UCRL-53053-80-Vol-3) Avail: NTIS HC A16/MF A01

Energy storage devices and propulsion systems likely to provide credible alternatives to current and future petroleum-fueled automobiles were examined. Energy storage automobiles, their performance and vehicle characteristics, propulsion, transmission and control equipment, cost estimates, and safety are among the factors addressed. DOE

N81-30054# California Univ., Livermore. Lawrence Livermore Lab.
ALUMINUM-AIR BATTERIES FOR VEHICLES
Ervin Behrin and John F. Cooper 23 Feb. 1981 15 p refs Presented at the 1st Intern. Energy Agency Conf. on New Energy Conservation Technol. and Their Commercialization, Berlin, 6-10 Apr. 1981 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-85605; CONF-810423-1) Avail: NTIS HC A02/MF A01

The aluminum-air battery is an advanced electrochemical energy source in the early stages of development. The battery is potentially capable to providing an electric vehicle with the range, acceleration, and rapid refueling capability of the automobile. Peak cell energy yields above 4 kWh/kg-Al and peak power densities greater than 6 kW/sq m have been demonstrated in single cells. Projected energy density and power density of a complete vehicle battery are greater than 300 Wh/kg and 150 W/kg. The concept, technical status, development strategy, and the results of battery and vehicle analyses are reviewed. DOE

N81-30379# Eaton Corp., Southfield, Mich.
USE OF ELASTOMERS IN REGENERATIVE BRAKING SYSTEMS
1981 28 p refs Presented at the Rubber Div. Meeting of the Am. Chem. Soc., Minneapolis, 1-5 Jun. 1981
(W-7405-eng-48)
(UCRL-15353; CONF-810648-1) Avail: NTIS HC A03/MF A01

The storage of potential energy as strain energy in elastomers was investigated. The evolution of the preferred stressing scheme is described, and test results on full-size elastomeric energy storage units sized for an automotive regenerative braking system application are presented. The need for elastomeric material improvements is also discussed. DOE

N81-30687# Battelle Pacific Northwest Labs., Richland, Wash.
COMPRESSED AIR ENERGY STORAGE TECHNOLOGY PROGRAM Annual Report
L. D. Kannberg Jun. 1981 201 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3804) Avail: NTIS HC A10/MF A01

Major research funded under the Compressed Air Energy Storage Technology Program during the period March 1980 to March 1981 is reported. The annual report is divided into two segments: (1) reservoir stability studies and (2) second generation concepts studies. The first study represents research performed

to establish stability criteria for CAES reservoirs while the second study reports progress on research performed on second generation CAES concepts. DOE

N81-30697# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 7: SITE INVESTIGATION: DEEP DRILLING Final Report
Apr. 1981 250 p refs Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-7; DOE/ET-5047/7) Avail: NTIS HC A11/MF A01

The results of the deep drilling program performed on the Sunshine Site from January to August 1979 are presented. The work included continuous core drilling and sampling of the Sykesville to a vertical depth of 2556 ft, in hole geophysical logging, determination of rock permeability and stresses, and rock testing. DOE

N81-30698# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES: UPH. APPENDIX A: UPPER RESERVOIR Final Report
Apr. 1981 91 p Prepared in cooperation with Potomac Electric Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-8-App-A; DOE/ET-5407/8A) Avail: NTIS HC A05/MF A01

Overriding considerations including operating range, volume and lining of reservoir, embankment design, intake/outlet arrangements and filling and make up water provisions were studied within the context of minimizing facility costs and optimizing the plant layout. The study led to the selection of a reservoir formed by embankment of compacted rockfill together with an intake/outlet structure located in the embankment. The reservoir floor and upstream slopes of the embankment will have an asphalt lining to prevent leakage. The material and cost estimates presented are based on the requirements for a 2000 MW plant providing 20,000 MWh of storage with a nominal head of 4600 ft. DOE

N81-30699# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES: UPH. APPENDIX C: HEAVY HOIST Final Report
Apr. 1981 157 p Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-8-App-C; DOE/ET-5047/8C) Avail: NTIS HC A08/MF A01

Overriding considerations, including type of hoist, capacity limitations, operating speed, haulage ropes, guides, conveyance, and landings were studied within the context both of feasibility and of minimizing equipment costs. The study led to the selection of a twin drum, twin electric drive hoist, and for depths as much as 5000 ft, hoist capacities of up to 300 tons were found to be feasible. A brief reference is made to the requirements for hoisting equipment other than for heavy loads. DOE

N81-30600# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES. UPH. APPENDIX E: LOWER RESERVOIR Final Report
Apr. 1981 157 p refs Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-8-App-E; DOE/ET-5047/8E) Avail: NTIS HC A08/MF A01

Operational, construction, and geotechnical requirements were examined. Overriding considerations including operating range, volume, construction methods, cavern cross section and reservoir layout were studied within the context of minimizing facility costs and optimizing the plant layout. The study led to a preliminary arrangement of fourteen parallel caverns, each 60 ft wide by 85 ft high in cross section and 3810 ft in length. The requirements for and preliminary design of the intermediate reservoir in the case of a two step UPH facility is also described. The design and the cost estimates presented are based on the requirements for a 2000 MW plant providing 20,000 MWh of storage at a nominal head of 4600 ft. DOE

N81-30601# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 9: DESIGN APPROACHES. CAES. APPENDIX B: CHAMPAGNE EFFECT Final Report
Apr. 1981 126 p refs Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-20013; EPRI Proj. 1081-1)
(EPRI-EI4-1589-Vol-9-App-B; DOE/ET-5047/9B) Avail: NTIS HC A07/MF A01

The significance of the release of dissolved air from the water in the water shaft during air compression on the design and operation of a hydrolically compensated CAES plant was investigated. This air release phenomena was named the Champagne Effect. Included is a description of the work to investigate the rate of diffusion of air into water, the rate of the subsequent release of air from the water during passage up the water shaft, and an evaluation of the resulting behavior of the air bubbles in the shaft. Also included is a discussion of dynamic modeling. Simulation was based upon a two fluid model of the PEPCO system and includes an analysis of potential modifications to the design that might further mitigate any operation problems. DOE

N81-30602# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 9: DESIGN APPROACHES. CAES. APPPENDIX E: ELECTRICAL SYSTEMS Final Report
Apr. 1981 149 p Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-9-App-E; DOE/ET-5047/9E) Avail: NTIS HC A07/MF A01

The design approaches provided the basis for development of the preliminary plant design. The electrical systems described include the plant power system, switchyard and electrical motor starting system. The design approaches presented are based on the design criteria presented in the Project Design criteria - CAES. Selection of the preferred approach reflect the Task 3 study results and conform to the greatest extent possible with PEPCO's standard practices. DOE

N81-30603# Nuclear Utility Services, Inc., Rockville, Md.
PRELIMINARY DESIGN STUDIES OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 10: ENVIRONMENTAL STUDIES Final Report
Apr. 1981 351 p refs Prepared in cooperation with Acres American, Inc., Buffalo, N.Y. Sponsored in part by Electric Power Research Inst. and Potomac Electric Power Co., Washington, D.C.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-10; DOT/ET-5047/10) Avail: NTIS HC A16/MF A01

Results of preliminary environmental assessments for a proposed UPH or CAES demonstration facility are presented. Included are characterizations of the existing environment of the sunshine site in Montgomery County, Maryland, and assessments of environmental impacts and public safety concerns. Elements of the existing environment which are considered sensitive are described. Environmental impacts are identified, rated, and described for both alternative demonstration facilities. Public safety concerns for both alternative demonstration facilities are also identified and discussed. These include, for both UPH and

CAES, underground cavern collapse and surface subsidence, explosives, site security, icing, upper reservoir failure, and mechanical failure of plant equipment. In addition, fuel handling and the champagne effect are addressed for CAES. DOE

N81-30604# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 13: CAUPH PRELIMINARY LICENSING DOCUMENTATION Final Report
Apr 1981 187 p refs Prepared in cooperation with Potomac Electric Power Co., Washington, D.C. Sponsored in part by Electric Power Research Corp.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(EPRI-EM-1589-Vol-13; DOE/ET-5047/13) Avail: NTIS HC A09/MF A01

An implementation plan and schedule was developed for the period from project authorization by the sponsor through receipt of all required regulatory authorizations. The documentation is based upon review of all pertinent regulations on the federal, state and local level of government, review of other publications, acquisition of applicable guides and forms, and discussions with responsible agency representatives. The implementation plan is specific to the requirements within the State of Maryland: the plan is based primarily upon the state's siting procedure which provides coordinated state agency approvals. Notwithstanding the site specific nature of the plan, many of the regulatory requirements, as well as the approach to implementation, should be suitable for general reference in developing licensing plans for CAES or UPH facilities. DOE

N81-30611# Lincoln Lab., Mass. Inst. of Tech., Lexington.
OPERATIONAL EXPERIENCES IN LEAD-ACID BATTERIES FOR PHOTOVOLTAIC SYSTEMS
Bronwyn L. Brench 1981 6 p refs Presented at the 15th IEEE PV Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-78ET-20279)
(DOE/ET-20279/118; CONF-810526-18) Avail: NTIS HC A02/MF A01

Photovoltaic systems which use different kinds of lead acid batteries, including units normally used for starting, lighting, and ignition (SLI) and for motive power are discussed. Four of these battery subsystems, particularly battery type versus system load, versus performance characteristics, and versus expected lifetime, are compared and analyzed. DOE

N81-30612# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PERFORMANCE CHARACTERISTICS OF SOLAR-PHOTOVOLTAIC FLYWHEEL-STORAGE SYSTEMS
P. O. Jarvinen, Bronwyn L. Brench, and Neil E. Rasmussen 1981 6 p refs Presented at the 15th IEEE Photovoltaic Specialist Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-78ET-20279)
(DOE/ET-20279/134; CONF-810526-23) Avail: NTIS HC A02/MF A01

A solar photovoltaic energy flywheel storage and conversion system for residential application was tested. Performance and efficiency measurements were conducted on the system, which utilizes low loss magnetic bearings, maximum power point tracking of the photovoltaic array, integrated permanent magnet motor generator, and output power conditioning sections of either the stand alone cycloconverter or utility interactive inverter type. The overall in/out electrical storage efficiency of the flywheel system was measured along with the power transfer efficiencies of the individual components and the system spin down tare losses. The system compares favorably with systems which use batteries and inverters. DOE

N81-30624# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
RECENT TECHNOLOGY IMPROVEMENTS IN EXXON'S CIRCULATING ZINC-BROMINE BATTERY SYSTEM
Richard J. Bellows 1981 23 p Presented at the 4th DOE Battery and Electrochem. Contractor's Conf., Washington, D.C., 2 Jun. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-7116C; CONF-810642-1) Avail: NTIS HC A02/MF A01

Electrode and electrolyte performance on 500 wH and 3 kWh units were studied. It was indicated that Exxon's circulating zinc-bromine battery in 20 kWh designs is capable of high energy density and turn around efficiency. The performance, coupled with factory cost projections of $28/kWh, makes zinc-bromine an attractive advanced battery candidate for not only photovoltaic, but also electric vehicle and bulk energy storage applications. DOE

N81-30625# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
RECENT PROGRESS ON EXXON'S CIRCULATING ZINC-BROMINE BATTERY SYSTEM
Richard J. Bellows 1981 19 p Presented at the 4th DOE Battery and Electrochem. Contractor's Conf., Washington, D.C., 2 Jun. 1981
(Contract DE-AC04-76DP-00789)
(SAND-81-7115C; CONF-810642-4) Avail: NTIS HC A02/MF A01

The design, performance, and factory cost of Exxon's circulating zinc bromine batteries are described. The Exxon system has demonstrated stable performance in scaleups to 3 and 10 kWh sub modules. Cost studies based on recently demonstrated extrusion and injection molding techniques, show that this battery, with plastic electrodes, bipolar stacks, Br2 complexation, and circulating electrolytes, can be produced at a factory cost of $28/kWh. DOE

N81-30628# California Univ., Livermore. Lawrence Livermore Lab.
SAFETY OF ISOTROPIC FLYWHEELS
Martin W. Schwartz 30 Apr. 1981 11 p refs Presented to the 5th Intern. Conf. on Fracture ICF5, Cannes, France, 29 Mar. - 30 Apr. 1981 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84347; CONF-810373-1) Avail: NTIS HC A02/MF A01

A probabilistic safety criterion for isotropic flywheel rotors based on the tolerated noncontainment failures rates of commercial aircraft turbojet engine rotors was established. A technique is developed combining reliability with fracture mechanics. A sample calculation is provided to show the energy storage levels that isotropic flywheel rotors could achieve within the constraints of this safety criterion. DOE

N81-30635# Maryland Univ., College Park.
REVIEW OF NATIONAL TECHNO-ECONOMIC ENERGY MODELS WITH PARTICULAR REFERENCE TO THE EVALUATION OF ENERGY STORAGE CONSIDERATIONS
William B. Widhelm and Thomas H. Doyle Dec. 1980 404 p refs
(Contracts DE-FG01-79ET-2685; DE-AS05-77ET-26940)
(DOE/ET-26940/T1; BN-964) Avail: NTIS HC A18/MF A01

Economic considerations used in developing National Techno-Economic (NTEE) models are presented. Methods for comparing NTEE models are discussed; specific NTEE models are described; and possible uses of NTEE models in energy storage studies are examined. DOE

N81-30638# Argonne National Lab., Ill.
HEAT-TRANSFER MODELING AND THERMAL MANAGEMENT OF BATTERIES
N. P. Yao 1980 12 p refs Presented at the 89th Nat. Meeting of the Am. Inst. of Chem. Engr., Portland, Oreg., 17-20 Aug. 1980
(Contract W-31-109-eng-38)
(CONF-800802-27) Avail: NTIS HC A02/MF A01

Thermal behavior of the battery and its thermal management, an important operational problem which would directly affect life cycle, safety, and also the cost of the batter were examined. Two commercial applications for secondary batteries, i.e., electric vehicles and electric utility load leveling, are discussed. Thermal management problems unique to various battery systems are reviewed. An example of engineering modeling which provides methodology for analysis of and engineering solutions to the battery thermal problem is presented. DOE

N81-31294# Avco Systems Div., Wilmington, Mass.
TOWARD OPTIMIZATION OF THE WOVEN FLYWHEEL
Alan D. Sapowith and William E. Handy 1 Jun. 1981 9 p refs
(Contract W-7405-eng-48)
(UCRL-15359) Avail: NTIS HC A02/MF A01

A constant stress composite flywheel incorporates fibers in the two principal stress directions: radial and circumferential. This design concept, along with two basic fabrication methods, is described. The low cost fabrication approach which incorporates a spiral weave is evaluated for its energy storage capacity. In this evaluation, several extremes of weave design are considered. It is concluded that flywheel performance depends primarily on maximizing the hoop fiber count and determining through experimentation the optimum fiber volume fraction for the composite. DOE

N81-31630*# PRC Systems Sciences Co., Huntsville, Ala.
ELECTROCHEMICAL ENERGY STORAGE SUBSYSTEMS STUDY, VOLUME 1 Final Contractor Report, Oct. 1979 - Sep. 1981
Fred Q. Miller, Peter W. Richardson, C. L. Graff, M. V. Jordan, and V. L. Patterson Sep. 1981 341 p refs 2 Vol.
(Contract NAS3-21962)
(NASA-CR-165420-Vol-1) Avail: NTIS HC A15/MF A01 CSCL 10C

The effects on life cycle costs (LCC) of major design and performance technology parameters for multi kW LEO and GEO energy storage subsystems using NiCd and NiH2 batteries and fuel cell/electrolysis cell devices were examined. Design, performance and LCC dynamic models are developed based on mission and system/subsystem requirements and existing or derived physical and cost data relationships. The models define baseline designs and costs. The major design and performance parameters are each varied to determine their influence on LCC around the baseline values. E.A.K.

N81-31631*# PRC Systems Sciences Co., Huntsville, Ala.
ELECTROCHEMICAL ENERGY STORAGE SUBSYSTEMS STUDY, VOLUME 2 Final Contractor Report, Oct. 1979 - Sep. 1981
Fred Q. Miller, Peter W. Richardson, C. L. Graff, M. V. Jordan, and V. L. Patterson Sep. 1981 259 p refs 2 Vol.
(Contract NAS3-21962)
(NASA-CR-165420-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 10C

The effects on life cycle costs (LCC) of major design and performance technology parameters for multi kW LEO and GEO energy storage subsystems using NiCd and NiH2 batteries and fuel cell/electrolysis cell devices were examined. Design, performance and LCC dynamic models are developed based on mission and system/subsystem requirements and existing or derived physical and cost data relationships. The models are exercised to define baseline designs and costs. Then the major design and performance parameters are each varied to determine their influence on LCC around the baseline values. E.A.K.

N81-31684# Varta Batterie A.G., Hanover (West Germany).
FABRICATION AND TESTING OF A PROTOTYPE GAS-RECOMBINATION DEVICE FOR UTILITY LEAD-ACID CELLS Final Report, 1 Aug. 1979 - 31 Mar 1980
A. Winsel, H. Laig-Hoerstebrock, K. Ledjeff, M. Tochtermann, and R. Schneider Aug. 1980 78 p refs
(Contract W-31-109-eng-38)
(ANL/OEPM-80-8) Avail: NTIS HC A05/MF A01

A prototype hydrogen-oxygen gas recombination device (HORD) was fabricated. The 435-W HORD was tested for performance and gas recombination efficiency using cyclinder H2 and O2 gases at various ratios and at various gas flow rates; high (100%) recombination efficiencies were obtained at all conditions tested. Temperature profiles of the HORD showed an even temperature distribution with no hot spots. The pressure was found to be dependent on the pressure of surplus gases. Higher outside temperatures had a negligible effect on performance. The stibine-arsine removal device was found to be very effective; removal efficiencies may be decreased if water vapor condenses on the activated charcoal. The HORD was also tested with a lead-acid cell over a cycle simulating a typical utility load-leveling application. The system operated gas-tight and maintenance-free. Safety applicances are discussed for cases of high and low explosive gas concentrations inside the HORD. A theoretical model of HORD operation is presented. DOE

N81-31688# CALMAC Mfg. Co., Englewood, N. J.
SALT-HYDRATE THERMAL-ENERGY-STORAGE SYSTEM FOR SPACE HEATING AND AIR CONDITIONING Final Report, 1 Dec. 1977 - 30 Jun. 1980
Calvin D. MacCracken, John M. Armstrong, Mark M. MacCracken, and Brian M. Silvetti 1980 86 p refs
(Contracts DE-AC02-78CS-34698; EM-78-C-02-4698)
(DOE/CS-34698/T1) Avail: NTIS HC A05/MF A01

Latent heat storage equipment using three different salts was developed. The salts are: sodium sulfate pentahydrate which melts at 460 C, magnesium chloride hexahydrate which melts at 1150 C, and a eutectic combination of seven different materials which melts at 70 C. Stirring pumps, tanks, and tubing materials, and field filling of the salts into their tanks are developed. good performance for the tank/heat exchangers with all three salts is reported. Both the 1150 C and 460 C salts are almost equivalent in volume storage to water/ice. The 79.0 C salt, however, begins at about 56% of the BTU's per cubic foot of water/ice and declines due to separation to 40% after repeated cycling. DOE

N81-32608*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
A REDOX SYSTEM DESIGN FOR SOLAR STORAGE APPLICATIONS
A. W. Nice and Norman H. Hagedorn 1981 9 p refs Presented at the 4th Battery and Electrochem. Contractors' Conf., Washington, D.C., 2-4 Jun. 1981 Sponsored by DOE
(Contract DE-AI04-80AL-12726)
(NASA-TM-82720; DOE/NASA/12726-14; E-1019) Avail: NTIS CSCL 10A

Redox energy storage systems developed for solar power applications and utility load leveling applications are described. The technology readiness of Redox energy storage for transfer of the technology to industry for product development and commercialization by industry is addressed. The design features of Redox systems for application to stand alone or residential storage requirements are described. Redox system designs with 3 to 10 kW power output and storage times of 6 to 250 hours are summarized and performance characteristics presented. J.M.S.

N81-32612*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
INITIAL GUIDELINES AND ESTIMATES FOR A POWER SYSTEM WITH INERTIAL (FLYWHEEL) ENERGY STORAGE
Luther W. Slifer, Jr. Dec. 1980 11 p
(NASA-TM-82134) Avail: NTIS HC A02/MF A01 CSCL 10A

Goals for the flywheel system are defined in terms of efficiency train estimates and mass estimates for the system components. The inertial storage power system uses a 5 kw-hr flywheel storage component at 50 percent depth of discharge (DOD). It is capable of supporting an average load of 3 kw, including a peak load of 7.5 kw for 10 percent of the duty cycle, in low Earth orbit operation. The specific power goal for the system is 10 w/kg, consisting of a 56 w/kg (end of life) solar array, a 21.7 w-hr/kg (at 50 percent DOD) flywheel, and 43 w/kg power processing (conditioning control and distribution). T.M

N81-32614# Potomac Electric Power Co., Washington, D.C.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 4: SYSTEM PLANNING STUDIES Final Report
Apr. 1981 94 p Prepared in cooperation with Acres American, Inc., Columbia, Md.
(Contract DE-AC02-77ET-28013)
(DE81-025263; EPRI-EM-1589-Vol-4) Avail: NTIS HC A05/MF A01

Preliminary design and planning studies of water compensated compressed air energy storage (CAES) and underground pumped hydroelectric (UPH) power plants are presented. The costs of the CAES and UPH plant designs, and the results of economic evaluations performed for the PEPCO system are presented. The PEPCO system planning analysis was performed in parallel stages with plant design development. Analyses performed early in the project indicated a requirement for 1000 MW/10,000 MWH of energy storage on a daily operating schedule, with economic installation in two segments of 500 MW in 1990 and 1997. The analysis was updated eighteen months later near the end of the project to reflect the impact of new growth projections and revised plant costs. The revised results indicated economic installations for either UPH or CAES of approximately

675 MW/6750 MWH on a daily cycle, installed in blocks of approximately 225 MW in 1990, 1993 and 1995. Significant savings in revenue requirements and oil fuel over the combustion turbine alternative were identified for both CAES and UPH. DOE

N81-32623# University of Southern Illinois, Carbondale.
LONGTERM SOLAR HEAT STORAGE IN AN UNDERGROUND WATER CISTERN RETROFITTED WITH THERMAL INSULATION Final Technical Report, 15 May 1979 - 31 Mar. 1981
Walter L. Borst 18 Jun. 1981 20 p refs
(Grant DE-FG02-79RS-10106)
(DOE/RS-10106/3) Avail: NTIS HC A02/MF A01

An existing, large underground water cistern was retrofitted with urethane insulation and waterproofing to determine the feasibility of the longterm storage of solar heat and environmental coolness. The thermal characteristics of the storage, heat storage times and interactions between storage and surrounding soil were measured. A 15.3 sq m solar collector was site built to provide the desired heat for storage. The heat was transported in a closed loop to a parallel tube heat exchanger, which was positioned vertically in the cistern. The experimental approach and results for a longterm energy storage system are described. DOE

N81-32625# Department of Energy, Washington, D. C.
ENVIRONMENTAL ASSESSMENT. AQUIFER THERMAL ENERGY STORAGE PROGRAM
Jan. 1981 66 p refs
(DOE/EA-0131) Avail: NTIS HC A04/MF A01

The probable environmental consequences of developing and applying aquifer thermal energy storage were examined. The thermal energy is stored in the aquifer until needed. At recovery, the second well is pumped, and the hot (or chilled) water circulated through the heat exchanger to recapture the stored energy, and the water is returned to the aquifer through the first well. Useable thermal energy is derived from waste heat sources, cogeneration, or from climate derived sources. The thermal energy is stored during periods of low demand and retrieved for various uses. Projects under consideration are located in different regions of the United States, and will store thermal energy as hot water and chilled water. Proposed action, alternatives to the proposed action, the environment affected by the proposed action, and the potential environmental consequences of the proposed action are discussed. DOE

N81-32647# Argonne National Lab., Ill.
ANNUAL SYNOPSIS OF BATTERY SUPPORT RESEARCH, FISCAL YEAR 1980
G. M. Cook May 1981 39 p refs
(Contract W-31-109-eng-38)
(ANL/OEPM-81-3) Avail: NTIS HC A03/MF A01

The improvement of the performance of lead acid, Ni/Zn, and Ni/Fe batteries, especially those for electric vehicles or utility load leveling applications are examined. The following projects are described: lead acid and nickel/zinc battery studies, battery modeling, and analysis and evaluation projects. Summaries of work published or presented during the year are also included. DOE

N81-32664# United Technologies Corp., South Windsor, Conn. Electrical Systems Group.
ADVANCED CONVERTER TECHNOLOGY Technical Progress Report, 23 May 1979 - 22 May 1980
C. V. Banic, S. A. Eckhouse, F. J. Kornbrust, K. Lifman, J. L. Peterson, R. W. Rosati, and D. Young 1980 144 p refs
(Contract DE-AC01-79ET-29079)
(DOE/ET-29079/T1) Avail: NTIS HC A07/MF A01

An advanced converter system for use in electrochemical energy storge was defined. Improved and experimental apparatus are designed to measure these characteristics and to enable better definition of the battery power conditioner interface. Improvement of energy storage system performance through modification of battery converter characteristics is investigated. Power conditioning based on fuel cell use was evaluated. It is concluded that this high switching frequency concept has the potential for significantly reducing the size and cost of battery plant power conditioners. DOE

N81-32674# California Univ., Livermore. Lawrence Livermore Lab.

FLYWHEELS: MOBILE APPLICATIONS
David W. Rabenhorst (APL, Laurel, Md.) 17 Jun. 1981 18 p refs
(Contract W-7405-eng-48)
(DE81-026567; UCRL-15363) Avail: NTIS HC A02/MF A01

The characteristics of modern flywheel energy storage systems uniquely qualify the flywheel for use in a variety of road vehicles, off road vehicles and rail vehicles. About sixty studies and various demonstration programs in a dozen countries indicate that future such flywheel powered vehicles will have improved performance, reduced energy and fuel consumption and reduced life cycle cost. Flywheel capabilities and mobile applications were reviewed. DOE

N81-33620# Argonne National Lab., Ill.
ADVANCED-BATTERY TECHNOLOGIES: WHERE ARE THEY NOW?
Neng-Ping Yao 1980 43 p refs Presented at the Ind. Chem. Session Mod. Eng. and Technol. Seminar, Taipei, Taiwan, 7-25 Jul. 1980
(Contract W-31-109-eng-38)
(CONF-8007103-1) Avail: NTIS HC A03/MF A01

Near term and advanced secondary batteries for application to electric utility load leveling, electric vehicles, and solar photovoltaic power systems are reviewed. Lead acid, iron nickel oxide, and zinc nickel oxide systems are the potential near term candidates for electric vehicle applications. In the near term EV battery program, technological progress was made in the area of specific energy, specific power, and manufacturing engineering. Cycle life enhancement and reduction of battery cost are emphasized. In parallel to the near term battery program is the research and development of advanced batteries which have potentials of higher performance and lower cost. DOE

N81-33624# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 9: DESIGN APPROACHES: CAES Final Report
Apr. 1981 191 p
(Contract DE-AC02-77ET-28013; EPRI Proj. 5047-9)
(DE81-027704; EPRI-EM-1589-Vol-9) Avail: NTIS HC A09/MF A01

During Task 3C of the PEPCO/CAES study detailed design requirements and alternate designs were developed for the major components and systems of the CAES plant. Based upon a preliminary economic and technical evaluation, preferred designs were chosen as the basis for subsequent development in Task 5C. A summary of the project design criteria, a pressure optimization study, and the design approaches for the major plant systems which were developed are presented. The performance, operation and control capabilities of the plant and the results of the preliminary cost estimate are reported. T.M.

N81-33633# Science Applications, Inc., Palo Alto, Calif.
RELIABILITY OF MODULARIZED ENERGY STORAGE SYSTEMS Interim Report
S. L. Basin Electric Power Research Inst. Jun. 1981 200 p refs Sponsored by the Electric Power Research Inst.
(EPRI Proj. 370-17)
(DE81-903725; EPRI-EM-1890) Avail: NTIS HC A10/MF A01

The reliability of modularized electric battery energy storage systems is discussed. The measures of performance include: (1) the time to first failure of the system; (2) the time between successive system failure; (3) available capacity, and (4) the number of module replacements over the planned system lifetime. The effect of module aging, under the assumption of a family of monotone failure rate distribution, is considered. DOE

N81-33853# Department of Energy, Washington, D. C.
PROGRESS AND FORECAST IN ELECTRIC-VEHICLE BATTERIES
W. H. Webster, Jr. and N. P. Yao 1980 9 p refs Presented at Intern. Congr. on Transportation, Dearborn, Mich., 15 Sep. 1980
(Contract W-31-109-eng-38)
(DE81-023833; CONF-800939-2) Avail: NTIS HC A02/MF A01

A battery development program for near term electric vehicles

was undertaken. The program's overall objective is to develop commercially viable batteries for commuter vehicles and for vans and trucks. Three near term battery are discussed: improved lead acid, nickel/iron and nickel/zinc systems. Progress was made in improving the specific energy, specific power, and manufacturing processes of these three battery technologies. Emphasis is on reduction of manufacturing cost and enhancement of battery cycle life and reliability. The zinc chloride battery is the fourth near term battery. DOE

N81-33655# Sandia Labs., Albuquerque, N. Mex. Battery Evaluation Lab.

TESTING BATTERIES FOR PHOTOVOLTAIC POWER SYSTEMS

A. E. Verardo, P. C. Butler, D. M. Bush, and D. W. Miller 1981 10 p refs Presented at the IECEC Conf., Atlanta, 9-21 Aug. 1981

(Contract DE-AC04-76DP-00789)

(SAND-81-0226C; CONF-810812-6) Avail: NTIS HC A02/MF A01

A battery evaluation laboratory was established to investigate the application of various battery technologies for energy storage in a photovoltaic power system. The evaluation laboratory provides a controlled test environment in which batteries can be exposed to any one or all of the following: (1) long term performance testing; (2) accelerated life testing; (3) simulated photovoltaic power system operational testing. Several battery systems are being tested. A description is presented of the laboratory and the tests currently being conducted and a brief description of the battery systems under test. DOE

N81-33664# Accumulation-Fabrik A.G., Soest (West Germany) Zentrallab.

BIPOLAR LEAD ACCUMULATOR CELL WITH HIGH ENERGY DENSITY Final Report

Reiner Kiessling Bonn Bundesministerium fuer Forschung und Technologie Nov 1980 109 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-115; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 22.90

In order to increase the energy density, a cellular design using light weight bipolar electrodes was studied. The reduced water consumption lowers the requirements on maintenance. The negative electrode is made of lead-plated copper. An 80 to 100 micron protecting layer of lead is sufficient because there is no anodic corrosion. Copper itself, in contact with negative active material, remains stable within the range of the usual electrochemical potentials. The alumin positive electrode requires a protecting lead layer of at least 250 microns, without pinholes or other defects, against anodic corrosion. Author (ESA)

N81-34101# California Univ., Livermore. Lawrence Livermore Lab.

FUTURE POSSIBILITIES FOR ENERGY-STORAGE AUTOMOBILES

L. G. OConnell 23 Apr. 1981 20 p refs Presented at 91st Natl. Meeting of the Am. Inst. of Chem. Engr. Detroit, 16 Aug. 1981

(Contract W-7405-eng-48)

(DE81-769416; UCRL-85902; CONF-810814-1) Avail: NTIS HC A02/MF A01

The future of energy storage devices for use in automobile propulsion systems is assessed. Future device characteristics are projected. The propulsion system is analyzed. Future energy storage automobiles were conceptually designed and compared to each other and the baseline internal combustion engine vehicle for several levels of performance. DOE

08
GENERAL

A81-41694 **Improvement of mechanical properties of Cu-Ti alloys by new process.** Y. Nishi, H. Aoyagi, T. Suzuki, and E. Yajima (Tokai University, Hiratsuka, Kanagawa, Japan). In: Titanium '80 science and technology; Proceedings of the Fourth International Conference on Titanium, Kyoto, Japan, May 19-22, 1980. Volume 2. Warrendale, PA, Metallurgical Society of AIME, 1980, p. 1419-1425. 6 refs.

A new process is proposed for producing Cu-Ti spring alloys. The new process, which involves quenching from the liquid state, makes it possible to directly obtain supersaturated crystal solid solution without many energy-consuming pretreatments (solution treatment, cold working, and prolonged aging now used in the commercial process. The maximum hardness obtainable with the new process is equal to that of cold-worked (20%) Cu-5 at % Ti alloys. With an additional 10 at % Ti, the maximum hardness equals that of an alloy cold-worked to a 50% reduction. The most important advantage of the new process is shortened aging for maximum hardness. V.L.

A81-41847 **From sponge to powder alternatives in titanium processing.** R. Ruthardt, H. Stephan, and W. Dietrich (Leybold-Heraeus GmbH, Hanau, West Germany). In: Titanium '80 science and technology; Proceedings of the Fourth International Conference on Titanium, Kyoto, Japan, May 19-22, 1980. Volume 3. Warrendale, PA, Metallurgical Society of AIME, 1980, p. 2289-2299.

Alternative techniques for the production of titanium ingots and powder from raw material ingots, sponge, powder or scrap are examined in light of the material requirements for high-efficiency aircraft gas turbine engines. Attention is given to vacuum arc and electron beam melting methods for the production of titanium ingots, and methods for titanium powder production from the melt which combine melting techniques such as arc, plasma or electron beam melting with means for melt disintegration generally based on centrifugal forces. The environmental cleanliness of the various processes is discussed, and cost considerations in the development of powder production equipment are addressed. A.L.W.

A81-42685 **Determination of kinetic parameters of combustion processes using optical detection techniques.** J. A. Silver (Aerodyne Research, Inc., Bedford, MA). *Optical Engineering*, vol. 20, July-Aug. 1981, p. 540-545. 28 refs. Contract No. ET-78-C-01-3183.

A high-temperature fast flow reactor has been used in conjunction with resonance lamp and laser-induced fluorescence to obtain reaction rates and identify different product channels for the purpose of elucidating the thermal deNOx chemical mechanisms. Experimental data are then used to develop a comprehensive computer model which describes the features of the NHi/NOx chemical system. V.L.

A81-43701 **SOUTHEASTCON '80; Proceedings of the Region 3 Conference and Exhibit, Nashville, TN, April 13-16, 1980.** Conference and Exhibit sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 378 p. Members, $18.75; nonmembers, $25.

Topics discussed include microelectronics, radar command and control, system theory, antennas, solar technology, signal processing, millimeter and submillimeter wave techniques, and digital system design. Also considered are communications, network theory, bit-slice processors, simulation and aerospace systems, microwave theory and techniques, biomedical engineering, energy technology, applied physics, and computer design and verification. B.J.

A81-44626 **Space - Enhancing technological leadership; Proceedings of the Twenty-seventh Annual Meeting, Boston, MA, October 20-23, 1980.** Conference sponsored by AAS, AIAA, Avco Corp., et al. Edited by L. P. Greene (U.S. Department of Transportation, Transportation Systems Center, Cambridge, MA). San Diego, CA, American Astronautical Society (Advances in the Astronautical Sciences. Volume 44); Univelt, Inc., 1981. 627 p. $85.

Papers on systems and technology research are presented, and include such general topics as communication and navigation, solar energy, meteorology, earth resources, materials processing in space, space transportation, and defense applications. Special attention is given to the NAVSTAR Global Positioning System, space manufacturing for the Solar Power Satellites, bridge and spider-web type structures in space, and the Space Shuttle. K.S.

A81-44631 **Man's role in space - The far potential.** H. L. Mayer (Aerospace Corp., El Segundo, CA). In: Space - Enhancing technological leadership; Proceedings of the Twenty-seventh Annual Meeting, Boston, MA, October 20-23, 1980. San Diego, CA, American Astronautical Society; Univelt, Inc., 1981, p. 263-278. (AAS 80-229)

The optimum role of man in space is discussed in view of future space macro-engineering projects which will necessitate direct human interference in space. Four examples of the macro-projects are presented, and man's potential contributions to them are examined in detail. In the worldwide, multipurpose, microwave-laser communication system, man would be useful in the deployment or assembly of the microwave antennas on orbit, in the initial adjustment of system components, in their maintenance, repair, and periodic replacement. A system for the disposal of the 1-100 year nuclides in low earth orbit is described, and it is shown that the essential role for man in this system stems from the potential danger of radioactive waste disposal. For the space solar power station, man's presence is necessitated by the size of the industrial structure. Man will be needed for monitoring, correcting the mistakes, and repairing and replacing the automata on the Soletta. Man's role in space, based on his economic value to all the projected programs, is discussed. K.S.

A81-44663 * # **Synergistic erosion/corrosion of superalloys in PFB coal combustor effluent.** S. M. Benford, G. R. Zellars, and C. E. Lowell (NASA, Lewis Research Center, Cleveland, OH). *American Ceramic Society, Annual Meeting, 82nd, Chicago, IL, Apr. 28-30, 1980, Paper.* 25 p. 13 refs.

Two Ni-based superalloys were exposed to the high velocity effluent of a pressurized fluidized bed coal combustor (PFBC). Targets were 15-cm diameter rotors operating at 40,000 rpm and small flat plate specimens. Above an erosion rate threshold (approximately 10 microns/hr), the targets were eroded to bare metal. The presence of accelerated oxidation at lower erosion rates suggests erosion/corrosion synergism. Various mechanisms which may contribute to the observed oxide growth enhancement include erosive removal of protective oxide layers, oxide and subsurface cracking, and chemical interaction with sulfur in the gas and deposits through damaged surface layers. (Author)

A81-44676 **SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981.** Conference and Exhibit sponsored by the Institute of Electrical and Electronics Engineers. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981. 934 p. Members, $36.; nonmembers, $48.

The subjects discussed are related to microelectronics, radar systems, power systems, systems theory, bio-engineering, pattern recognition, electromagnetics, Kalman filtering, communications, computer systems, digital signal processing, software engineering, multiprocessor systems, digital filters, computerized speech systems, the automation of power distribution systems, aerospace applications, pattern recognition applications, education, energy systems, antennas, filters applications, electronic devices, power applications, missile image processing applications, devices, instrumentation, new sensor systems, modeling and simulation, environmental aspects, military applications, microprocessor systems design aids, control systems, communication systems, computer aided design, avionics, coding, microprocessor applications, and propagation and scattering. Attention is given to a high-g plastic gyro with wide-angle radiant energy pickoffs, an autonomous, fast-reaction strapdown inertial navigation system, a land navigation system with a precision azimuth and elevation, avionics integrated support facility developments, an

interconnection system for spacecraft distributed control and data collection, an analysis of a new inertial measuring system for aerospace vehicles, and an aircraft landing system employing observers. G.R.

A81-48328 **Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings.** Conference sponsored by AGU, AIAA, AMS, BMES, IMACS, IEEE, ISA, SCS, and S.H.A.R.E. Arlington, VA, AFIPS Press, 1980. 771 p. $40.

Topics examined include computer hardware, software, and systems; modeling methodology; validation and verification; graphics; socioeconomic models; simulation and training; dynamic systems; management sciences; and the application of computer models in energy and resource utilization, transportation, and biological, medical, and ecological systems. Particular consideration is given to an integrated compartment method for the numerical solution of Navier-Stokes equations, an artificial intelligence approach to large-scale simulation, the evolution of real-time digital simulation of aircraft for training applications, time delays in flight simulator visual displays, and the determination of cargo container inventories through logistics simulation. B.J.

A81-48918 **High temperature corrosion in energy systems.** R. A. Rapp (Ohio State University, Columbus, OH), J. H. Devan (Oak Ridge National Laboratory, Oak Ridge, TN), D. L. Douglass (California, University, Los Angeles, CA), P. C. Nordine (Yale University, New Haven, CT), F. S. Pettit (Pittsburgh, University, Pittsburgh, PA), and D. P. Whittle (California, University, Berkeley, CA). *Materials Science and Engineering*, vol. 50, Sept. 1981, p. 1-17. 36 refs. Contract No. DE-AS02-76ER-01198.

High temperature corrosion in energy systems is considered, focusing on specific corrosion problems critical to each group of energy systems, i.e., nuclear, solar, coal combustion and conversion, and oil and gas recovery. Recommendations are made for basic fundamental research in direct support of the known corrosion problems in specific energy systems, and include: (1) a study of the effects of several trace gaseous impurities (particularly chlorine) on the growth and damaging of protective oxide scales, and on the degradation of alloy mechanical properties; (2) high resolution in situ scanning electron microscopy for clarifying uncertain scale growth mechanisms; (3) an examination of the effect of solid deposits, either reactive or relatively inert, on gas-alloy attack; (4) electrochemical studies of alloy corrosion in deep salt melts or slags, where the gaseous environment is remote from the alloy surface; and (5) a study of the influences of temperature gradients and heat fluxes on material compatibility, redistribution of chemical components, and properties of corrosion product layers. K.S.

N81-29027*# California Inst. of Tech., Pasadena.
PUBLICATIONS OF THE JET PROPULSION LABORATORY 1980
15 Jul. 1981 32 p
(NASA-CR-164836; JPL-Bibl-39-22) Avail: NTIS HC A03/MF A01 CSCL 05B

The Bibliography cites 385 externally distributed technical reports, released during calendar year 1980, that resulted from scientific and engineering work performed, or managed, by the Jet Propulsion Laboratory. Three classes of publications are included: (1) JPL Publications (77-, 78-, 79-series, etc.); (2) articles published in the open literature; and (3) articles from the bimonthly Deep Space Network (DSN) Progress Report (42 series) and its successor, the Telecommunications and Data acquisition (TDA) Progress Report (also 42-series). The citations are listed alphabetically by primary author. A.R.H.

N81-29063*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AEROSPACE IN THE FUTURE
John F. McCarthy, Jr. May 1980 34 p Presented at CECON, Cleveland, 20-21 May 1980
(NASA-TM-82864; E-575) Avail: NTIS HC A03/MF A01 CSCL 05A

National research and technology trends are introduced in the environment of accelerating change. NASA and the federal budget are discussed. The U.S. energy dependence on foreign oil, the increasing oil costs, and the U.S. petroleum use by class are presented. The $10 billion aerospace industry positive contribution to the U.S. balance of trade of 1979 is given as an indicator of the positive contribution of NASA in research to industry. The research work of the NASA Lewis Research Center in the areas of space, aeronautics, and energy is discussed as a team effort of government, the areas of space, aeronautics, and energy is discussed as a team effort of government, industry, universities, and business to maintain U.S. world leadership in advanced technology. A.R.H.

N81-29064# National Bureau of Standards, Washington, D.C.
NBS DIMENSIONS, VOLUME 64, NO. 10 Monthly Report Dec. 1980 37 p
(PB81-170276; NBS-DIM-64-10) Avail: NTIS HC A03/MF A01 CSCL 14B

Summaries of major technical developments, highlights of work in progress, major speeches and statements by Bureau management, and a listing of NBS publications are presented. Contents for this issue are: An Effective National Program, H. Baum; Southern Exposure (passive solar technology), G. Metz; Arson Sniffers (portable vapor detectors), E. Rudin; Neutron Radiography Used for Inspecting Jet Engines, G. Porter; Traceable Standard Issued, SRM; Activities in Wood-Heating Safety, I. Peacock, and Fluidic Temperature Sensors, T. Negas. GRA

N81-29582# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND TECHNOLOGY REVIEW
May 1981 43 p refs
(Contract W-7405-eng-48)
(UCRL-52000-81-5) Avail: NTIS HC A03/MF A01

Research programs are reviewed. Validation of the pulsed power design for FXR (flash X-ray machine) the NOVA plasma shutter, thermal control of the MFTF (mirror fusion test facility) superconducting magnet, a low energy X-ray spectrometer for pulsed source diagnostic, micromachining, the electronics engineer's design station, and brazing with a laser microtorch is discussed. DOE

N81-31038*# University of Southern California, Los Angeles. NASA Industrial Application Center.
ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 4: BIBLIOGRAPHY
D. H. Maund [1981] 44 p 4 Vol.
(Contract NAS2-10794)
(NASA-CR-166238-Vol-4; DRB-320-Vol-4) Avail: NTIS HC A03/MF A01 CSCL 13B

A bibliography is presented for the Advanced Technology Display House. Information sources used in generating the design concepts studied are included. S.F.

N81-31672# Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Cologne (West Germany).
[ACTIVITIES REPORT ON AEROSPACE AND ENERGY RESEARCH] Annual Report, 1979 [JAHRESBERICHT 1979]
1980 165 p refs In GERMAN Original contains color illustrations
Avail: NTIS HC A08/MF A01

Research in the following areas is described: (1) transport and communication systems; (2) aircraft; (3) space flight techniques; (4) exploration techniques; (5) energy and drilling technology. Research facilities are described, including the German-Dutch wind tunnel, the European transonic cryogenic wind tunnel, and the Spacelab simulator. Author (ESA)

N81-31910# Sheffield Univ. (England). Dept. of Control Engineering.
CASE STUDIES IN COMPUTER CONTROL
J. B. Edwards Mar. 1981 78 p refs
(RR-145) Avail: NTIS HC A05/MF A01

The computer control of three different processes is investigated. These processes are longwall coal cutting, electric vehicle testing, and a pilot distillation column. Analytical process modelling, control theory and computer control strategies are investigated from the systems engineering viewpoint. Test procedures, safety aspects and specifications for hardware and software components are discussed. The benefits to be derived are considerably greater than in ordinary applications of computer control. It is also claimed that those processes cannot operate efficiently without computer control. Author (ESA)

N81-33586*# Denver Research Inst., Colo. Program for Transfer Research and Impact Studies.
SPACE BENEFITS: THE SECONDARY APPLICATION OF AEROSPACE TECHNOLOGY IN OTHER SECTORS OF THE ECONOMY
[1981] 240 p refs
(Contract NASw-3113)
(NASA-CR-164733) Avail: NTIS HC A11/MF A01 CSCL 05A

Some 585 examples of the beneficial use of NASA aerospace technology by public and private organizations are described to demonstrate the effects of mission-oriented programs on technological progress in the United States. General observations regarding technology transfer activity are presented. Benefit cases are listed in 20 categories along with pertinent information such as communication link with NASA; the DRI transfer example file number; and individual case numbers associated with the technology and examples used; and the date of the latest contract with user organizations. Subject, organization, geographic, and field center indexes are included. A.R.H.

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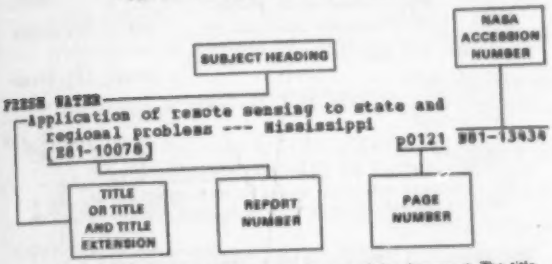
Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title or title and title extension provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any subject heading the accession numbers are arranged in sequence with the AIAA ac-- accession numbers appearing first.

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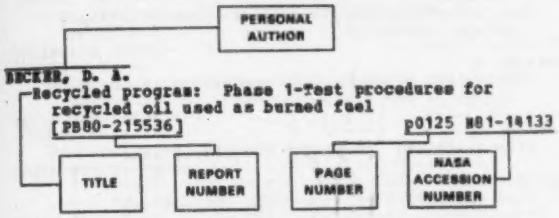

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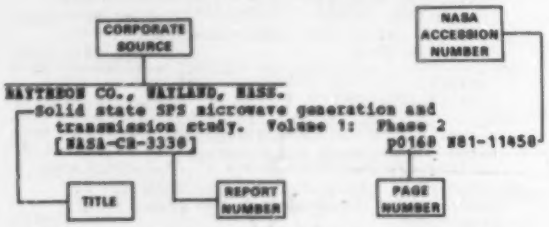

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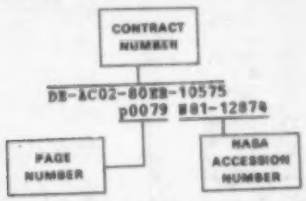

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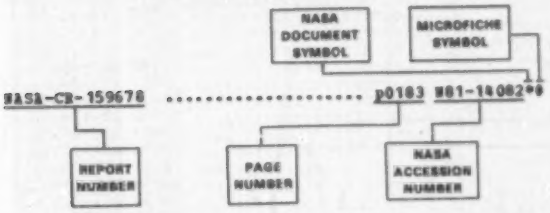

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DE81-028189 ..... p0606 N81-32679 #
DE81-028332 ..... p0655 N81-33314 #
DE81-028375 ..... p0682 N81-34031 #
DE81-028400 ..... p0610 N81-33629 #
DE81-028494 ..... p0680 N81-33099 #
DE81-028538 ..... p0682 N81-34034 #
DE81-028654 ..... p0680 N81-33086 #
DE81-028751 ..... p0653 N81-32687 #
DE81-028762 ..... p0606 N81-32684 #
DE81-028869 ..... p0610 N81-33638 #
DE81-028905 ..... p0653 N81-32589 #
DE81-029002 ..... p0609 N81-33623 #
DE81-029003 ..... p0610 N81-33641 #
DE81-029004 ..... p0610 N81-33642 #
DE81-029005 ..... p0610 N81-33643 #
DE81-029006 ..... p0611 N81-33644 #
DE81-029007 ..... p0611 N81-33645 #
DE81-029008 ..... p0682 N81-33646 #
DE81-029009 ..... p0678 N81-32673 #
DE81-029010 ..... p0611 N81-33647 #
DE81-029011 ..... p0656 N81-33648 #
DE81-029030 ..... p0611 N81-33649 #
DE81-029087 ..... p0611 N81-33650 #
DE81-029106 ..... p0559 N81-33680 #
DE81-029124 ..... p0560 N81-33686 #
DE81-029129 ..... p0604 N81-32655 #

DE81-029282 ..... p0610 N81-33635 #
DE81-029283 ..... p0610 N81-33630 #
DE81-029289 ..... p0609 N81-33628 #
DE81-029290 ..... p0609 N81-33627 #
DE81-029294 ..... p0680 N81-33171 #
DE81-029394 ..... p0607 N81-33414 #
DE81-029834 ..... p0558 N81-33201 #
DE81-029944 ..... p0682 N81-34027 #
DE81-029988 ..... p0655 N81-33318 #
DE81-029990 ..... p0558 N81-33489 #
DE81-102509 ..... p0602 N81-32459 #
DE81-769405 ..... p0656 N81-33657 #
DE81-769416 ..... p0699 N81-34101 #
DE81-769623 ..... p0612 N81-33660 #
DE81-903302 ..... p0555 N81-32711 #
DE81-903452 ..... p0651 N81-32296 #
DE81-903725 ..... p0698 N81-33633 #

DGLR PAPER 81-029 ..... p0664 A81-47579 #
DGLR PAPER 81-080 ..... p0578 A81-47598 #
DGLR PAPER 81-081 ..... p0577 A81-47593 #

DOE/BC-10043/25 ..... p0647 N81-31392 #
DOE/BETC/RI-81/2 ..... p0540 N81-29242 #
DOE/CE-0001 ..... p0546 N81-30630 #
DOE/CE-0005 ..... p0625 N81-29252*#
DOE/CE-0008 ..... p0693 N81-29585 #
DOE/CE-0012 ..... p0605 N81-32663 #
DOE/CE-0017 ..... p0554 N81-32658 #
DOE/CE-20100/1 ..... p0640 N81-29575 #
DOE/CE-20167/05 ..... p0645 N81-30621 #
DOE/CE-20237/1 ..... p0649 N81-31667 #
DOE/CE-50022/1 ..... p0634 N81-28283 #
DOE/CE-56051/3 ..... p0638 N81-29258 #
DOE/CE-60467/02 ..... p0539 N81-28596 #
DOE/CH-10003/1 ..... p0686 N81-31678 #
DOE/CS-10046/2-VOL-1 ..... p0552 N81-31660 #
DOE/CS-10046/2-VOL-2 ..... p0552 N81-31661 #
DOE/CS-20278/T5-VOL-4 ..... p0610 N81-33643 #
DOE/CS-20300/1 ..... p0655 N81-33317 #
DOE/CS-30120/T1 ..... p0589 N81-29573 #
DOE/CS-30133/T1-VOL-2 ..... p0590 N81-29574 #
DOE/CS-30202/T3 ..... p0559 N81-33632 #
DOE/CS-30217/T1 ..... p0601 N81-31668 #
DOE/CS-30248/T1 ..... p0603 N81-32637 #
DOE/CS-30278/T6-VOL-7 ..... p0682 N81-33646 #
DOE/CS-30278/T7-VOL-5 ..... p0611 N81-33644 #
DOE/CS-30278/T8-VOL-11 ..... p0611 N81-33649 #
DOE/CS-30278/T9-VOL-6 ..... p0611 N81-33645 #
DOE/CS-30278/T10 ..... p0678 N81-32673 #
DOE/CS-30278/T11-VOL-10 ..... p0656 N81-33648 #
DOE/CS-30278/T12-VOL-3 ..... p0610 N81-33642 #
DOE/CS-30278/T13-VOL-9 ..... p0611 N81-33647 #
DOE/CS-30278/T14-VOL-12 ..... p0611 N81-33650 #
DOE/CS-30278/T15 ..... p0609 N81-33623 #
DOE/CS-30278/T16-VOL-2 ..... p0610 N81-33641 #
DOE/CS-30579/T1 ..... p0605 N81-32657 #
DOE/CS-31072/1 ..... p0592 N81-30255 #
DOE/CS-31521/T1 ..... p0612 N81-33658 #
DOE/CS-31522/T2 ..... p0600 N81-31655 #
DOE/CS-32117/T1 ..... p0605 N81-32662 #
DOE/CS-32144/T1 ..... p0597 N81-30573 #
DOE/CS-32867/T1 ..... p0587 N81-29399 #
DOE/CS-32867/T2 ..... p0587 N81-29396 #
DOE/CS-34135/T4 ..... p0600 N81-31659 #
DOE/CS-34193/T1 ..... p0588 N81-29537 #
DOE/CS-34479/3 ..... p0583 N81-28545 #
DOE/CS-34698/T1 ..... p0697 N81-31669 #
DOE/CS-40037/T3 ..... p0652 N81-32313 #
DOE/CS-40177/T2 ..... p0648 N81-31396 #
DOE/CS-40284/T1 ..... p0540 N81-29217 #
DOE/CS-40327/T1 ..... p0653 N81-32447 #
DOE/CS-40352/T2 ..... p0541 N81-29539 #
DOE/CS-50069/T1 ..... p0558 N81-33201 #
DOE/CS-50226/1 ..... p0541 N81-29560 #
DOE/DC-30220/T2 ..... p0649 N81-32223 #
DOE/EA-0119 ..... p0556 N81-32727 #
DOE/EA-0131 ..... p0698 N81-32625 #
DOE/EIA-0174/80-2 ..... p0583 N81-28533 #
DOE/EIA-0262/1 ..... p0547 N81-30639 #
DOE/EIA-0288 ..... p0552 N81-31642 #
DOE/EIA-10189/T2 ..... p0586 N81-28591 #
DOE/EP-0015 ..... p0553 N81-31685 #
DOE/EP-0021 ..... p0560 N81-33681 #
DOE/ER-0099 ..... p0541 N81-29546*#
DOE/ER-10160/T4 ..... p0686 N81-28589 #
DOE/ER-10160/T5 ..... p0598 N81-30594 #
DOE/ER-10190/T1 ..... p0586 N81-29255 #
DOE/ER-10682/2 ..... p0644 N81-30500 #

DOE/ET-5047/7 ..... p0695 N81-30597 #
DOE/ET-5047/8C ..... p0695 N81-30599 #
DOE/ET-5047/8E ..... p0695 N81-30600 #
DOE/ET-5047/9D ..... p0695 N81-30601 #
DOE/ET-5047/9E ..... p0695 N81-30602 #
DOE/ET-5047/10 ..... p0695 N81-30603 #
DOE/ET-5047/13 ..... p0696 N81-30604 #
DOE/ET-5407/8A ..... p0695 N81-30598 #
DOE/ET-04502/7 ..... p0634 N81-28289 #
DOE/ET-10069/T4 ..... p0647 N81-31389 #
DOE/ET-10104/2 ..... p0638 N81-29261 #
DOE/ET-10104/7 ..... p0651 N81-32303 #
DOE/ET-10145/64 ..... p0644 N81-30504 #
DOE/ET-10255/1-PT-1 ..... p0638 N81-29256 #
DOE/ET-10325/T6 ..... p0650 N81-32226 #
DOE/ET-10325/T8 ..... p0650 N81-32227 #
DOE/ET-10328/33 ..... p0651 N81-32304 #
DOE/ET-10340/T3 ..... p0670 N81-29450 #
DOE/ET-10340/T4 ..... p0670 N81-29449 #
DOE/ET-10340/111 ..... p0681 N81-33490 #
DOE/ET-10679/T10 ..... p0642 N81-30299 #
DOE/ET-10744/T3 ..... p0647 N81-31390 #
DOE/ET-10775/T1 ..... p0682 N81-33637 #
DOE/ET-10805/T1-VOL-2 ..... p0679 N81-33059 #
DOE/ET-10805/T1-VOL-3 ..... p0679 N81-33060 #
DOE/ET-10805/T1-VOL-4 ..... p0680 N81-33061 #
DOE/ET-10805/T1-VOL-5 ..... p0680 N81-33062 #
DOE/ET-10805/T1-VOL-6 ..... p0680 N81-33063 #
DOE/ET-10805/T1-VOL-7 ..... p0679 N81-33038 #
DOE/ET-10815/T4 ..... p0675 N81-31518 #
DOE/ET-11054/T1 ..... p0652 N81-32310 #
DOE/ET-11305/T7 ..... p0669 N81-28543 #
DOE/ET-11305/T8 ..... p0541 N81-29545 #
DOE/ET-12056/12 ..... p0656 N81-33586 #
DOE/ET-12082/9 ..... p0644 N81-30503 #
DOE/ET-12442/T2 ..... p0556 N81-32715 #
DOE/ET-12548/7 ..... p0556 N81-33576*#
DOE/ET-12866/3 ..... p0674 N81-30572 #
DOE/ET-12866/6 ..... p0680 N81-33438 #
DOE/ET-12866/9 ..... p0678 N81-32650 #
DOE/ET-13384-T2 ..... p0653 N81-32448 #
DOE/ET-14372/T1 ..... p0651 N81-32301 #
DOE/ET-14700/6 ..... p0655 N81-33312 #
DOE/ET-14801/12 ..... p0643 N81-30404 #
DOE/ET-14806/T4 ..... p0647 N81-31391 #
DOE/ET-14876/T4 ..... p0655 N81-33314 #
DOE/ET-14881/T1 ..... p0638 N81-29263 #
DOE/ET-15346/T1 ..... p0670 N81-29363 #
DOE/ET-15350/1 ..... p0542 N81-29580 #
DOE/ET-15518/4 ..... p0679 N81-33056 #
DOE/ET-15529/T2 ..... p0682 N81-34034 #
DOE/ET-15601/T4 ..... p0682 N81-34027 #
DOE/ET-15602/T5 ..... p0677 N81-32449 #
DOE/ET-15611/T2 ..... p0679 N81-33057 #
DOE/ET-15619/T1 ..... p0673 N81-29994 #
DOE/ET-20258/T1 ..... p0677 N81-32633 #
DOE/ET-20279/118 ..... p0696 N81-30611 #
DOE/ET-20279/122 ..... p0585 N81-28564 #
DOE/ET-20279/123 ..... p0598 N81-30580 #
DOE/ET-20279/125 ..... p0609 N81-33626 #
DOE/ET-20279/126 ..... p0585 N81-28565 #
DOE/ET-20279/127 ..... p0591 N81-29600 #
DOE/ET-20279/129 ..... p0585 N81-28566 #
DOE/ET-20279/131 ..... p0599 N81-30632 #
DOE/ET-20279/132 ..... p0598 N81-30579 #
DOE/ET-20279/134 ..... p0696 N81-30612 #
DOE/ET-20279/135 ..... p0599 N81-30609 #
DOE/ET-20279/137 ..... p0598 N81-30608 #
DOE/ET-20281/2 ..... p0672 N81-29572 #
DOE/ET-20356/1 ..... p0667 N81-33222*#
DOE/ET-20375/T1 ..... p0588 N81-29544 #
DOE/ET-20524/1-VOL-1 ..... p0605 N81-32675 #
DOE/ET-20524/1-VOL-2 ..... p0606 N81-32683 #
DOE/ET-21056/T3 ..... p0675 N81-31651 #
DOE/ET-21067/2 ..... p0648 N81-31397 #
DOE/ET-21109/T1 ..... p0590 N81-29579 #
DOE/ET-23116/80/1 ..... p0668 N81-28485 #
DOE/ET-23151/80/1 ..... p0641 N81-29712 #
DOE/ET-23170/80/1 ..... p0646 N81-30756 #
DOE/ET-26940/T1 ..... p0696 N81-30635 #
DOE/ET-27035/T1 ..... p0648 N81-31609 #
DOE/ET-27101/1 ..... p0645 N81-30662 #
DOE/ET-27163/8 ..... p0649 N81-31662 #
DOE/ET-28388/T1 ..... p0646 N81-30731 #
DOE/ET-29079/T1 ..... p0698 N81-32654 #
DOE/ET-29372/1 ..... p0546 N81-30560*#
DOE/ET-51010/9 ..... p0637 N81-28986 #
DOE/EV-03201/T4 ..... p0554 N81-32299 #
DOE/EV-10024/1 ..... p0537 N81-28290 #
DOE/EV-10454/T1 ..... p0540 N81-28622 #
DOE/FC-10169/T1 ..... p0543 N81-29663 #
DOE/FC-10226/T1 ..... p0556 N81-32717 #
DOE/FE-20223/1 ..... p0651 N81-32306 #
DOE/IA-0010/11 ..... p0541 N81-29551 #
DOE/ID-01570/T21-VOL-1 ..... p0672 N81-29595 #
DOE/ID-01570/T21-VOL-2-APP-A-K ..... p0676 N81-31652 #
DOE/ID-12089/T1 ..... p0672 N81-29617 #
DOE/ID-12098/T2 ..... p0601 N81-32311 #
DOE/ID-49004/1 ..... p0678 N81-32670 #
DOE/IR-05106/T6 ..... p0645 N81-30627 #
DOE/IR-05106/T24 ..... p0539 N81-28590 #
DOE/JPL-1060-45 ..... p0582 N81-28524*#
DOE/JPL-1060-46 ..... p0593 N81-30525*#
DOE/JPL-1060-47 ..... p0545 N81-30524*#
DOE/JPL-1060/21 ..... p0608 N81-33603*#
DOE/JPL-1060/44 ..... p0608 N81-33604*#
DOE/JPL-954334-19 ..... p0593 N81-30519*#
DOE/JPL-954521-81/15 ..... p0608 N81-33605*#
DOE/JPL-954833-81/4 ..... p0607 N81-33496*#
DOE/JPL-954976-81/13 ..... p0608 N81-33607*#
DOE/JPL-955699-81/04 ..... p0593 N81-30516*#
DOE/JPL-955825-81/2 ..... p0608 N81-33606*#
DOE/JPL-955894-3 ..... p0608 N81-33610*#
DOE/JPL-955902-81/2 ..... p0592 N81-30515*#
DOE/JPL-955909-81/3 ..... p0608 N81-33609*#
DOE/MC-08018/T1 ..... p0638 N81-29266 #
DOE/MC-08089/107 ..... p0538 N81-28292 #
DOE/MC-08216/157 ..... p0635 N81-28509 #
DOE/MC-08450/T2 ..... p0672 N81-29621 #
DOE/MC-11284/166 ..... p0555 N81-32710 #
DOE/METC-114 ..... p0636 N81-28653 #
DOE/METC/BI-178 ..... p0650 N81-32225 #
DOE/METC/SP-129 ..... p0635 N81-28452 #
DOE/NASA/0029-1 ..... p0681 N81-33602*#
DOE/NASA/0032-12 ..... p0549 N81-31032*#
DOE/NASA/0051-2 ..... p0675 N81-31632*#
DOE/NASA/0152-1 ..... p0654 N81-32603*#
DOE/NASA/0163-2 ..... p0668 N81-28516*#
DOE/NASA/0195-1 ..... p0602 N81-32605*#
DOE/NASA/0201-3 ..... p0671 N81-29527*#
DOE/NASA/1062-0 ..... p0674 N81-30973*#
DOE/NASA/3303-1 ..... p0675 N81-31628*#
DOE/NASA/10769-10 ..... p0676 N81-32026*#
DOE/NASA/12726-7 ..... p0668 N81-28519*#
DOE/NASA/12726-14 ..... p0697 N81-32608*#
DOE/NASA/20305-6 ..... p0681 N81-33492*#
DOE/NASA/20320-32 ..... p0671 N81-29528*#
DOE/NASA/20485-10 ..... p0582 N81-28517*#
DOE/NASA/51040-22 ..... p0673 N81-30562*#
DOE/NASA/51040-31 ..... p0676 N81-32087*#
DOE/NASA/51044-21 ..... p0675 N81-31627*#
DOE/NASA/51044-23 ..... p0687 N81-33484*#
DOE/NASA/281751 ..... p0554 N81-32088*#
DOE/NE-0030/1(81) ..... p0670 N81-29365 #
DOE/NV-10089/1 ..... p0653 N81-32593 #
DOE/PC-04049/T1 ..... p0676 N81-32224 #
DOE/PC-30018/T1 ..... p0652 N81-32315 #
DOE/PC-30027/9 ..... p0652 N81-32317 #
DOE/PC-30230/T2 ..... p0652 N81-32314 #
DOE/PC-30264/06 ..... p0654 N81-33258 #
DOE/PC-30291/T1 ..... p0652 N81-32323 #
DOE/PC-30296/T1 ..... p0560 N81-33686 #
DOE/PC-40270/1 ..... p0654 N81-33255 #
DOE/PC-40272/T1 ..... p0649 N81-32216 #
DOE/PETC/TR-81/2 ..... p0638 N81-29262 #
DOE/RA-50239/1 ..... p0678 N81-32660 #
DOE/RA-50366/T1 ..... p0649 N81-32089 #
DOE/RG-0058 ..... p0549 N81-30955 #
DOE/RG-10446/T1 ..... p0641 N81-30285 #
DOE/RG-10446/T2 ..... p0540 N81-29265 #
DOE/RS-10106/3 ..... p0698 N81-32623 #
DOE/RS-10112/T1 ..... p0603 N81-32619 #
DOE/RS-10120/2 ..... p0674 N81-30590 #
DOE/RS-10146/2 ..... p0588 N81-29538 #
DOE/RS-10236/2 ..... p0678 N81-32676 #
DOE/RS-10253/1 ..... p0588 N81-29541 #
DOE/RW-10031/T2 ..... p0636 N81-28540 #
DOE/S-0008 ..... p0554 N81-32638 #
DOE/SAN-2117/1 ..... p0605 N81-32662 #
DOE/SEA-3408-20691/81/1 ..... p0671 N81-29540 #
DOE/SEA-7315-2074/81/2 ..... p0539 N81-28576 #
DOE/SF-01910/T1 ..... p0546 N81-30582 #
DOE/SF-01973/T1 ..... p0585 N81-28569 #
DOE/SF-01975/T1 ..... p0654 N81-32656 #
DOE/SF-10499/T36 ..... p0606 N81-32682 #
DOE/SF-10499/T37 ..... p0606 N81-32681 #
DOE/SF-10538/T6 ..... p0669 N81-28544 #
DOE/SF-10538/T7 ..... p0639 N81-29452 #

DOE/SF-10549/T1 ..... p0587 N81-29403 #
DOE/SF-10607/T1 ..... p0591 N81-29609 #
DOE/SF-10756/1 ..... p0587 N81-29402 #
DOE/SP-10763/T9-VOL-1 ..... p0583 N81-28538 #
DOE/SP-10763/T9-VOL-2 ..... p0583 N81-28539 #
DOE/TIC-1022359 ..... p0552 N81-31646 #
DOE/TIC-1022361 ..... p0552 N81-31648 #

DOT-HS-805810 ..... p0551 N81-31555 #

DOT-TSC-NASA-81-1 ..... p0554 N81-32088*#

DPST-80-634 ..... p0651 N81-32302 #

DRB-320-VOL-1 ..... p0550 N81-31035*#
DRB-320-VOL-2 ..... p0550 N81-31036*#
DRB-320-VOL-3 ..... p0702 N81-31038*#

E-575 ..... p0702 N81-29063*#
E-676 ..... p0673 N81-30562*#
E-902 ..... p0676 N81-32087*#
E-906 ..... p0538 N81-28522*#
E-914 ..... p0671 N81-29528*#
E-944 ..... p0675 N81-31627*#
E-950 ..... p0674 N81-30973*#
E-956 ..... p0676 N81-32026*#
E-957 ..... p0647 N81-31380*#
E-979 ..... p0550 N81-31195*#
E-983 ..... p0687 N81-33484*#
E-1015 ..... p0681 N81-33492*#
E-1019 ..... p0697 N81-32608*#

EGG-GTH-5456 ..... p0680 N81-33086 #

EPA-AA-TEB-81-7 ..... p0541 N81-29457 #
EPA-AA-TEB-81-12 ..... p0637 N81-29159 #

EPA-460/3-81-002 ..... p0554 N81-32092 #
EPA-460/3-81-012 ..... p0544 N81-30278 #
EPA-600/J-81-137 ..... p0648 N81-31400 #
EPA-600/2-80-205B ..... p0553 N81-31691 #
EPA-600/2-81-017 ..... p0553 N81-31695 #
EPA-600/2-81-097 ..... p0560 N81-33703 #
EPA-600/7-81-020A ..... p0553 N81-31692 #
EPA-600/7-81-025 ..... p0543 N81-29691 #
EPA-600/7-81-030 ..... p0548 N81-30702 #
EPA-600/7-81-075 ..... p0560 N81-33704 #
EPA-600/7-81-090 ..... p0553 N81-31696 #
EPA-600/7-81-100 ..... p0560 N81-33705 #
EPA-600/7-81-103 ..... p0557 N81-32745 #
EPA-600/9-80-057A ..... p0544 N81-29777 #
EPA-600/9-80-057B ..... p0544 N81-29778 #
EPA-600/9-81-009 ..... p0545 N81-30313 #

EPRI-AP-1623-VOL-2 ..... p0670 N81-29443 #
EPRI-AP-1725 ..... p0537 N81-28291 #
EPRI-AP-1844 ..... p0643 N81-30450 #
EPRI-AP-1882-VOL-1 ..... p0676 N81-32300 #

EPRI-CS-1768 ..... p0639 N81-29515 #

EPRI-EA-1724 ..... p0539 N81-28582 #

EPRI-EL-1948 ..... p0686 N81-32403 #

EPRI-EM-1589-VOL-4 ..... p0697 N81-32614 #
EPRI-EM-1589-VOL-7 ..... p0695 N81-30597 #
EPRI-EM-1589-VOL-8-APP-A ..... p0695 N81-30598 #
EPRI-EM-1589-VOL-8-APP-C ..... p0695 N81-30599 #
EPRI-EM-1589-VOL-8-APP-E ..... p0695 N81-30600 #
EPRI-EM-1589-VOL-9 ..... p0698 N81-33624 #
EPRI-EM-1589-VOL-9-APP-E ..... p0695 N81-30601 #
EPRI-EM-1589-VOL-9-APP-E ..... p0695 N81-30602 #
EPRI-EM-1589-VOL-9-APP-E ..... p0695 N81-30603 #
EPRI-EM-1589-VOL-10 ..... p0696 N81-30604 #
EPRI-EM-1589-VOL-13 ..... p0671 N81-29550 #
EPRI-EM-1815 ..... p0598 N81-30591 #
EPRI-EM-1866 ..... p0698 N81-33633 #
EPRI-EM-1890 ..... p0677 N81-32307 #
EPRI-EM-1936 ..... p0555 N81-32711 #

EPRI-WS-79-220-VOL-2 ..... p0675 N81-31649 #

ESD-PUBL-1678 ..... p0591 N81-29609 #

ESG-80-22 ..... p0606 N81-32684 #

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16. Abstract

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ENERGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

Issue 33

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between January 1 and March 31, 1982 in

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(33)) lists 1211 reports, journal articles, and other documents announced between January 1, 1982 and March 31, 1982 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

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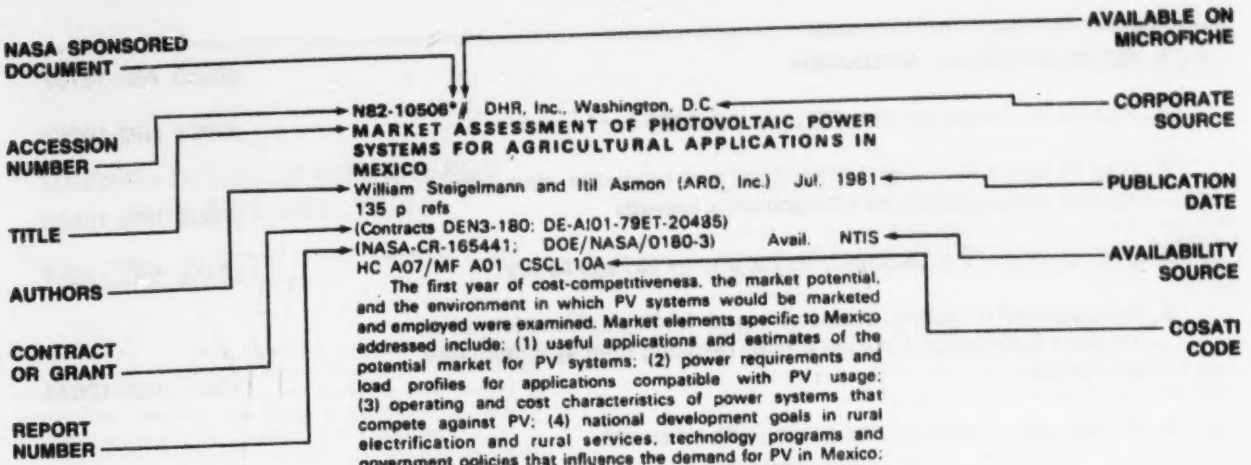

N82-10506*# DHR, Inc., Washington, D.C.

MARKET ASSESSMENT OF PHOTOVOLTAIC POWER SYSTEMS FOR AGRICULTURAL APPLICATIONS IN MEXICO

William Steigelmann and Itil Asmon (ARD, Inc.) Jul. 1981

135 p refs

(Contracts DEN3-180; DE-AI01-79ET-20485)

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The first year of cost-competitiveness, the market potential, and the environment in which PV systems would be marketed and employed were examined. Market elements specific to Mexico addressed include: (1) useful applications and estimates of the potential market for PV systems; (2) power requirements and load profiles for applications compatible with PV usage; (3) operating and cost characteristics of power systems that compete against PV; (4) national development goals in rural electrification and rural services, technology programs and government policies that influence the demand for PV in Mexico; (5) financing mechanisms and capital available for PV acquisition; (6) channels for distribution, installation and maintenance of PV systems; and (7) appropriate methods for conducting business in Mexico.

A.R.H.

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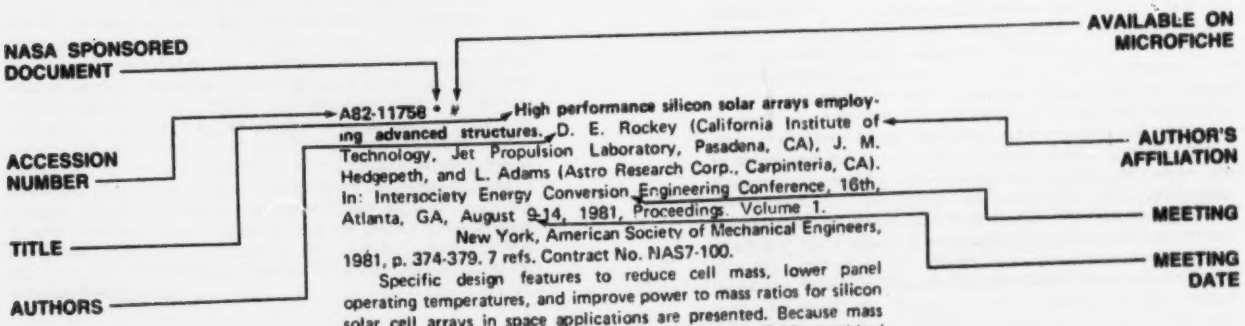

A82-11758 * # **High performance silicon solar arrays employing advanced structures.** D. E. Rockey (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), J. M. Hedgepeth, and L. Adams (Astro Research Corp., Carpinteria, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 374-379. 7 refs. Contract No. NAS7-100.

Specific design features to reduce cell mass, lower panel operating temperatures, and improve power to mass ratios for silicon solar cell arrays in space applications are presented. Because mass constraints limit payload capacity for launch into GEO, graphite/epoxy structures combined with high performance Si cells are needed to deliver a power/mass ratio of 265 W/kg, notably for Solar Electric Propulsion systems, compared with existing level of 65 W/kg. Shallow diffusion and back surface field cell technology have raised cell efficiencies to 15%, with a back emissivity of 1.64. Structural design requirements comprise Shuttle interface compatibility, full ground test capability, low mass, and high stiffness. Three array alternatives are discussed, and the STACBEAM configuration, which consists of a triangular truss and a piston deployer with folding accomplished on simple hinges, provides 0.2 Hz stiffness and achieves the design power/mass goals.

D.H.K.

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ENERGY

A Continuing Bibliography (Issue 33)

APRIL 1982

01
ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Includes energy requirements, energy conservation, and environmental impacts of energy systems.

A82-10495 # Characteristics and trends of energy consumption in transport missions with aircraft and surface vehicles (Caratteristiche e tendenze del consumo energetico nelle missioni di trasporto con aeroplani e con veicoli di superficie). G. Gabrielli. *Ingegneria*, July-Aug. 1981, p. 193-198. 6 refs. In Italian.

A nondimensional factor is defined which characterizes energy consumption in transport missions. Values of this energy utilization factor are given for a number of aircraft and surface vehicles (e.g., automobiles, buses, and trains). Particular attention is given to the energy utilization factor of turbofan and turbojet aircraft. B.J.

A82-10697 Fingerprinting pollutant discharges from synfuels plants. K. J. Bombaugh and K. W. Lee (Radian Corp., Austin, TX). *Environmental Science and Technology*, vol. 15, Oct. 1981, p. 1142-1149. 11 refs. Research sponsored by the U.S. Environmental Protection Agency.

An approach to the identification of ambient aerosols produced by a coal gasification plant based on their organic chemical composition is discussed. The method has been field tested successfully in the region of the Lurgi process plant in the Kosovo region of Yugoslavia, which produces four major liquid by-products: naphtha, medium oil, tar and crude phenol. In the study, gas chromatography in both the sulfur and nitrogen modes and gas chromatography/mass spectroscopy with selective ion scanning was used to detect the presence of the medium oil characteristics in chromatograms of ambient aerosols and vapors collected over a 16-day period at five locations approximately 1-2 km from the plant. With the aid of a calibration curve expressing the relation between GC retention time and boiling point for various compounds, chromatograms of the medium oil component were found to be similar to those gathered downwind of the plant. Comparisons between the chromatograms of nitrogen species in samples of water-soluble organics from the Kosovo plant and from a Chapman-Wilputte gasifier using Virginia bituminous coal also demonstrate the potential utility of the technique for differentiating between chemicaly similar emissions from different sources. A.L.W.

A82-10875 Characteristics of combustion and pollutant formation in swirling flames. T. Takagi and T. Okamoto (Osaka University, Suita, Japan). *Combustion and Flame*, vol. 43, Oct. 1981, p. 69-79. 24 refs.

The gas species concentrations and temperatures in a flame formed around a fuel jet surrounded by a swirling air flow are presented. Particular attention is given to the interrelation between the flame structure and the formation and emission characteristics of air pollutants. Two typical flame configurations are found to arise according to the primary air ratio: the type A flame has a low primary air ratio; increased NO(x) is formed in the flame and appears in the exhaust because the fuel layer burns at a relatively high temperature and the slow mixing retards the temperature decay. Low NO(x) formation occurs in the type B flame, which has a high primary air ratio; the fuel layer around the recirculation zone burns at a relatively low temperature as a result of dilution by excess air prior to combustion. Unburnt hydrocarbons are liable to be exhausted because hydrocarbons in the fuel layer around the recirculation zone, excessively diluted by the surrounding air, spill away through the circumferential part of the bulk flow. Hydrocarbons are not exhausted, however, when the total air ratio is less than two. Effects of a wide range of parameters on NO(x), CO, and hydrocarbon emissions are examined in connection with the flame configurations. J.F.

A82-11540 Annual review of energy. Volume 6. Edited by J. M. Hollander (California, University, Berkeley, CA), M. K. Simmons (General Electric Co., Schenectady, NY), and D. O. Wood (MIT, Cambridge, MA). Palo Alto, CA, Annual Reviews, Inc., 1981. 559 p. $20.

Developments in the areas of energy resources and supply technologies, energy end use and conservation, energy policy, energy-related risks and the sociopolitical aspects of energy are reviewed. Progress in solar energy technologies over the last five years is discussed, along with the implications for reactor safety of the accident at Three Mile Island, the derivation of biomass fuels from agricultural products and the application of probabilistic risk assessment to energy technologies. Attention is also given to a program for national survival during an oil crisis, energy conservation in new buildings, the development of a United States synthetic fuel industry, the role of OPEC policies in world oil availability, the social impacts of soft and hard energy systems, and the energy implications of fixed rail mass transportation systems. Additional topics include the energy consumptions of industries, the relative economics of nuclear, coal and oil-fired electricity generation, and the role of petroleum price and allocation regulations in the management of energy shortages. A.L.W.

A82-11542 Agricultural policies and biomass fuels. S. Flaim and D. Hertzmark (Solar Energy Research Institute, Golden, CO). In: Annual review of energy. Volume 6.
Palo Alto, CA, Annual Reviews, Inc., 1981, p. 89-121. 64 refs.

The potentials for biomass energy derived from agricultural products are examined. The production of energy feedstocks from grains is discussed for the example of ethanol production from grain, with consideration given to the beverage process and the wet milling process for obtaining fuel ethanol from grains and sugars, the nonfeedstock costs and energy requirements for ethanol production, the potential net energy gain from ethanol fermentation, the effect of ethanol fuel production on supplies of protein, oils and feed and of ethanol coproducts, net ethanol costs, and alternatives to corn as an ethanol feedstock. Biomass fuel production from crop residues is then considered; the constraints of soil fertility on crop residue removal for energy production are reviewed, residue yields with conventional practices and with reduced tillage are determined, technologies for the direct conversion of cellulose to ethanol and methanol are described, and potential markets for the products of these processes are identified. Implications for agricultural policy of ethanol production from grain and fuel and chemical production from crop residues are also discussed. A.L.W.

A82-11543 Factors in the development of a major US synthetic fuels industry. H. Perry and H. H. Landsberg (Resources for the Future, Inc., Washington, DC). In: Annual review of energy. Volume 6. Palo Alto, CA, Annual Reviews, Inc., 1981, p. 233-266. 48 refs. Contract No. ER-78-C-01-6654.

Conditions necessary for the development of a successful synthetic fuels industry in the United States which would reduce

dependence on imported liquid fuels are examined. Attention is given to the legislative background, the current status of alternative synfuels technologies including coal gasification, coal liquefaction, oil shale, and biomass conversion, resource requirements, environmental and socioeconomic constraints, and economic factors. Estimates are also presented of the rate of commercialization to be expected at various levels taking into account both physical and nonphysical constraints, and it is concluded that the rate of commercialization of synthetic fuels production should increase rapidly after the 1990s after the demonstration of technologies acceptance of regulatory requirements, and development of the required technological infrastructure. A.L.W.

A82-11845 # Energy conservation through utilization of mechanical energy storage. D. B. Eisenhaure, T. E. Bliamptis, J. R. Downer, and P. C. Heinemann (Charles Stark Draper Laboratory, Inc., Cambridge, MA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2154-2160.

Potential benefits regarding fuel savings, necessary technology, and evaluation criteria for the development of flywheel-hybrid vehicles are examined. A case study is quoted in which adoption of flywheel-hybrid vehicles in a taxi fleet would result in an increase of 10 mpg average to 32 mpg. Two proposed systems are described, one involving direct engine power to the flywheel and the second regenerating the flywheel from braking energy through a continuously variable transmission. Fuel consumption characteristics are considered the ultimate determinant in the choice of configuration, while material properties and housing shape determine the flywheel speed range. Vehicle losses are characterized and it is expected that a flywheel at 12,000 rpm will experience less than one hp average parasitic power loss. Flywheel storage is suitable for smaller engines because larger engines dominate the power train mass. Areas considered important for further investigation include reliability of an engine run near maximum torque, noise and vibration associated with flywheel operation, start up delays, compatibility of driver controls, integration of normal with regenerative braking systems, and, most importantly, the continuously variable transmission. M.S.K.

A82-12156 The annual variation of atmospheric CO2 concentration observed in the Northern Hemisphere. G. I. Pearman and P. Hyson (Commonwealth Scientific and Industrial Research Organization, Div. of Atmospheric Physics, Mordialloc, Victoria, Australia). *Journal of Geophysical Research*, vol. 86, Oct. 20, 1981, p. 9839-9843. 28 refs. NOAA-supported research.

Records of the annual variation of the atmospheric carbon dioxide concentration at Mauna Loa, Point Barrow, and Weathership P are examined for secular changes. The amplitude of the annual variation appears to have increased in recent years with a best estimate of the rate of change, based on the Mauna Loa data, of 0.45 + or - 0.42%/yr. This change is discussed in terms of changes in biospheric respiration and photosynthesis and the use of fossil fuels. The analysis does not allow for the separation of several possible causes of amplitude change. However, if the change is interpreted as reflecting enhanced biospheric growth, the effect is equivalent to a 6% change in the net summer uptake of carbon over the years 1959-1978 and to a growth of the Northern Hemisphere seasonal biosphere of 500-billion kg of carbon per year. Such a conclusion is consistent with recent inventory studies, which indicate that temperate zone forests have acted as a net sink of about 10-trillion kg of carbon per year in recent decades. (Author)

A82-12505 # Environmental factors of power satellites. Y. T. Chiu and B. K. Ching (Aerospace Corp., Space Sciences Laboratory, El Segundo, CA). In: International Scientific Conference on Space, 21st, Rome, Italy, March 25, 26, 1981, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1981, p. 43-52. 16 refs.

The paper delineates environmental factors associated with the construction and operation of a solar power satellite, with emphasis on the idea that these factors should play a central, not a subsidiary, role in defining the limits of the system. Particular attention is given to the biospheric environment (the ground level and troposphere), including launch-site effects and rectenna site effects; the upper atmospheric environment (tropopause to turbopause); and the near-space environment (turbopause to magnetopause), including HLLV exhausts and the F region, spacecraft emissions in the magnetosphere, and possible interactions of the microwave beam with the ionosphere. B.J.

A82-12547 Energy future: Prophets, profits and policies; Proceedings of the Seventh Annual UMR-DNR Conference on Energy, University of Missouri-Rolla, Rolla, MO, October 14-16, 1980. Volume 7. Conference sponsored by the Missouri Department of Natural Resources and University of Missouri-Rolla. Edited by J. D. Morgan (Missouri-Rolla, University, Rolla, MO). Rolla, MO, University of Missouri-Rolla, 1981. 344 p. $30.

Topics covered include industrial energy systems, biomass use, and energy management. Papers were presented on photovoltaic and wind electric systems, energy considerations in building design and standards, political and social aspects of energy systems, energy research technology, and environmental impacts of various hydrocarbon based fuel systems. M.S.K.

A82-12563 Fuel conservation - DC-9 series 20/30/40. *Society of Flight Test Engineers, Journal*, vol. 3, Sept. 1981, p. 2-17.

Operational performance penalties and approximate fuel costs associated with the aerodynamics, flight operations, fuel gage system and performance analysis aspects of the DC-9 Series 20, 30 and 40 aircraft are presented. Degradations in aerodynamic cleanness, caused by the gradual deterioration of various seals, rigging adjustments and skin surface smoothness, are shown to lead to drag increases of less than 0.5%, which, however, represents a significant cost in view of the amount of fuel consumed. Flying off-optimum altitude or Mach number may result in excess fuel expenditures greater than those due to degraded aerodynamic cleanness. Other operational factors with substantial influence on fuel use include fuel or aircraft weight, center of gravity, flight time, the use of automatic flight control systems, APU operation, engine starting times, takeoff procedures, climb speed, en route profile, descent profile, and approach maneuvers. The DC-9 fuel gage system has been designed to be as accurate as possible in all phases, in order to minimize the necessity of carrying excess fuel for a given flight. Finally, investigations of aircraft performance may be used to identify areas requiring correction through the comparison of the indicated performance level against a reference, the assessment of engine and airframe contributions, and the investigation of the most likely areas for correction - the external control surfaces and internal systems. S.C.S.

A82-13078 Fuel efficient flight profiles in an ATC flow management environment. R. W. Schwab (Boeing Commercial Airplane Co., Seattle, WA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1. New York, American Institute of Chemical Engineers, 1981, 6 p. (WA-1B).

The Flow Management research program was established to define the airborne navigation/guidance capabilities needed for efficient operation in the ATC Flow Management system under development; the Flow Management research is one element of the NASA Terminal Configured Vehicle program. This paper examines the Flow Management algorithms, and reviews in-plane geometry and ATC constraints, wind and temperature modeling, descent initialization, runway profile descent calculation, aeroperformance envelope determination, high profile descent calculation, and holding and path stretching. B.J.

A82-13457 # The role of avionics in the all electric airplane. M. J. Cronin (Lockheed-California Co., Burbank, CA). In: Digital Avionics Systems Conference, 4th, St. Louis, MO, November 17-19, 1981, Collection of Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1981, p. 47-55. 22 refs. (AIAA 81-2219)

The paper examines the role of avionics in the development of the all-electric airplane (AEP) as a viable and energy-efficient transport. It is noted that avionics will play a key role in the fuel and thrust management of the advanced-technology engines of the AEP via technology such as FADEC (full authority digital engine control).

Attention is also given to the important role of avionics in the flight control of future AEPs, operating with a relaxed static stability and advanced supercritical wings. The samarium-cobalt motor/generator development and the proliferating use of power electronics for engine starting/motor control are also discussed. B.J.

A82-14006 # Analysis of electric utility investments into wind power. F. March, E. H. Dlott, and R. C. McArthur (Arthur D. Little, Inc., Cambridge, MA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2537.* 9 p.

This paper uses a synthetic utility typical of the northeast United States, to evaluate an investment into 1000 MW of wind power, as a fuel saver, in the mid-1980s. The results of models that simulate the production cost savings, and the financial implications to the regulated utility are displayed. Under current regulatory and financial market conditions, an investor owned utility has no incentive to invest in wind energy, particularly when the technology is considered risky. A series of policy changes affecting the regulatory rules under which the utility operates are explored using the financial model to measure common stock issued, bond coverage, allowance for funds during conservation as percent of earnings, earnings, and cost to consumer. These results are projected over a 15 year period, providing insight into which policies are likely to result in effective incentives for wind energy investment. (Author)

A82-14009 # Siting and land-use considerations in wind energy development. R. J. Noun (Solar Energy Research Institute, Golden, CO). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2541.* 9 p. 43 refs.

Public and private issues affecting land-use requirements for the development of wind energy farms in the 30 kW to 3 MW range are discussed. Private concerns comprise agreements between owners of adjacent property, while public issues concentrate on legislative acts to protect wind energy access; minimizing land development restrictions in areas next to wind farms is the primary focus. Existing (one, 600 kW - 20 turbines), under construction, and planned wind farms are described, noting that a small difference in wind speeds can have a large effect on the economics of wind farms. Windpower is divided into quantity (the effect of turbulence on windspeed), and quality (the effect of turbulence on the lifetime of the wind turbine structure); the factors have a large impact on the physical array design of a wind farm and the life expectancy of a wind turbine. Measurement on a 200 kW Mod OA indicated wake turbulence clearance at 5 rotor diameters, although 20% velocity deficits were observed at 7 diameters. State legislative action to protect wind easement is reviewed, with private agreements providing specific binding clauses for airspace and wind rights between two landowners viewed as the best method. M.S.K.

A82-14021 # Florida's proposed OTEC pilot plant for Key West. D. L. Block, L. Rotundo (Florida Solar Energy Center, Cape Canaveral, FL), A. Griffin (TRW, Inc., Redondo Beach, CA), and T. Kelly (City Electric System, Key West, FL). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2563.* 6 p.

A description of the organizational structure, resource, and plant design for an OTEC system near Key West, Fla., is presented. A consortium of government offices has contracted with individual industrial developers to form an initial design team and manage subcontracting. Key West was chosen because of high electric rates, a proximity to warm and deep seawater, and a cooperative utility. Ocean water temperatures range from 80 F for the surface to 42 F for deep waters. A 40 MWe pilot plant is planned, with a double hull design for the 600-700 ft by 100-200 ft barge; four 15 MWe power modules will use ammonia as a working fluid. Strong available currents have reduced the needed sizes of the surface water intake ducts; less than two weeks down time are projected for hurricanes. The fiber reinforced composite cooling water pipe will be 2,600 ft long and designed to withstand hurricane stresses. Mooring and power delivery cabling are described, and it is noted that the design for the Key West plant is transferable to anywhere in the world due to the built-in engineering considerations. D.H.K.

A82-14024 # An estimate of OTEC costs, market potential and proof-of-concept vessel financing. R. Manley, J. Bluestein (Mitre Corp., McLean, VA), and E. J. Francis (Johns Hopkins University, Laurel, MD). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2567.* 14 p. 7 refs.

The cost and financing alternatives for the OTEC proof-of-concept experimental vessel and analysis of likely future markets for the technology are discussed. Financing alternatives include the benefits of 1980 legislation favoring OTEC investments as well as application of well known project financing techniques. Estimates of the cost of electricity to be provided by large-scale OTEC plants in the late 1980s are made and projections of OTEC's future competitiveness are offered. Additionally, estimates of OTEC's contribution to the industrial power market through OTEC plantship applications are made. Near-term investments in OTEC proof-of-concept vessels appear favorable under the financial conditions assumed and should be more favorable under the Economic Tax Recovery Act of 1981. The long-term contributions which OTEC could make to the nation's energy supply and the consequent reductions in import of foreign oil are substantial, if the technology is allowed to mature to full-scale status. (Author)

A82-14040 # Turboexpanders for OTEC power plants. J. Holm (Rotoflow Corp., Los Angeles, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2592.* 13 p. 9 refs.

Centripetal (radial inflow) turboexpanders are well adapted to energy conservation schemes. A mini OTEC demonstration program, completed in 1979, uses a closed ammonia cycle to drive a 50 kw turboexpander generator unit. The turboexpander, which incorporates mechanical designs of low temperature and high speed machinery, has very high levels of reliability and efficiency. Stiff shaft designs have eliminated shaft and bearing criticals in the entire operating range. Rotor resonance problems are almost totally eliminated, and thrust bearing problems can be accurately monitored and controlled. Condensing streams and dust in gas can also be handled without erosion. Designs for radial inflow turboexpanders in sizes up to 70 MWe are presently available for use in OTEC and other power plants. J.F.

A82-14347 * Chronic exposure of a honey bee colony to 2.45 GHz continuous wave microwaves. B. B. Westerdahl and N. E. Gary (California, University, Davis, CA). *Space Solar Power Review*, vol. 2, no. 3, 1981, p. 283-295. 8 refs. Research supported by the U.S. Department of Energy; Contract No. NAS2-9539.

A honey bee colony (Apis mellifera L.) was exposed 28 days to 2.45 GHz continuous wave microwaves at a power density (1 mW/sq cm) expected to be associated with rectennae in the solar power satellite power transmission system. Differences found between the control and microwave-treated colonies were not large, and were in the range of normal variation among similar colonies. Thus, there is an indication that microwave treatment had little, if any, effect on (1) flight and pollen foraging activity, (2) maintenance of internal colony temperature, (3) brood rearing activity, (4) food collection and storage, (5) colony weight, and (6) adult populations. Additional experiments are necessary before firm conclusions can be made. (Author)

A82-14404 Renewables in the U.S. energy future - How much, how fast. J. P. Holdren (California, University, Berkely, CA). *Energy* (UK), vol. 6, Sept. 1981, p. 901-916. 40 refs.

Comparisons are made of various projections of the contribution of several energy sources to the U.S. energy mix in the year 2000, along with conclusions on the effects of methods used to choose which systems receive emphasis. It is shown that energy-economic models predict renewable contributions of 1.5-24% of the total to be needed, depending on the set of assumptions utilized by the analyst and the definitions of renewable that were used. All studies showed a decoupling of energy consumption growth rates from an increase of economic growth, and a lessening of the rate of building large, conventionally fueled power plants. Scenarios making similar projections on the total use of renewables differed as to which technologies would make the contribution. Examples are provided for the use of

solar heating and thermoelectric conversion, wind, photovoltaics, OTEC, and biomass, and it is concluded that, while many energy futures are possible, the use of economics alone as a basis does not reflect the total cost of any particular energy system. D.H.K.

A82-14416 Wing design for light transport aircraft with improved fuel economy. D. Welte, R. Birrenbach, and W. Haberland (Dornier GmbH, Friedrichshafen, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 5, Sept.-Oct. 1981, p. 294-303. 5 refs. Research supported by the Bundesministerium für Forschung und Technologie.

Investigations related to the development of a new wing for a light transport aircraft were initiated by a German aerospace company in 1975. Flight tests for the evaluation of the new wing began in June 1979. The considered design incorporates a new wing section and a wing tip having a triangular shape. The induced drag observed in connection with the new wing tip is less than the corresponding value found for wing tips of conventional design. Tradeoff studies were conducted to optimize wing area and wing aspect ratio for the specified performance requirements. A use of the new wing design makes it possible to obtain aircraft with high maximum-lift values, low drag, and good stall characteristics. Attention is given to the wing parameter study, aspects of airfoil design, the flap design, the wing design, the aileron, and the merits of a number of different wing structures. G.R.

A82-14442 Evaporative hydrocarbon emissions from a large vehicle population. P. F. Nelson (Commonwealth Scientific and Industrial Research Organization, Div. of Fossil Fuels, North Ryde, New South Wales, Australia). *Air Pollution Control Association*, vol. 31, Nov. 1981, p. 1191-1193. 13 refs. Research supported by the SPCC of New South Wales.

Results of measurements of hydrocarbon emissions from parked cars in Sydney, Australia are presented. Concentrations of ethylene, acetylene, propylene, i-butane, n-butane, i-pentane, and n-pentane were determined for gasoline vapor, totally evaporated gasoline, and exhaust sources. Field samples were taken from the sole exhaust duct of an underground parking garage, and concentrations of each pollutant were obtained for the flow rate, emission rate for each source, and the weight fraction of the hydrocarbon species in the source. The hydrocarbons were identified by chromatography and the results were used to obtain solutions for the three sources by a least squares method. Comparisons of species concentration in the garage exhaust with the reference concentrations for the three sources indicated that evaporated gasoline was the pollutant source, with an average emission of 9.9 g/car, implying that evaporated gasoline from parked cars is a significant source of hydrocarbon emissions. M.S.K.

A82-14709 The all electric airplane - Its development and logistic support. M. J. Cronin (Lockheed-California Co., Burbank, CA). In: NAECON 1981; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-21, 1981. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 241-247. 19 refs.

Developmental and logistic support aspects that must be considered as a part of the development cycle of potentially large electric power systems are reviewed. Increasing fuel problems and their impact on the economic viability of commercial airlines are discussed. The hardware design, power generation system, environmental control system, and the engine starting system are also discussed. In addition, the impact of these large electric power systems on ground logistic support and operation from ground power units, auxiliary power units, and fixed-plant installations is considered. D.L.G.

A82-14924 Energy technology VII: Expanding supplies and conservation; Proceedings of the Seventh Conference, Washington, DC, March 24-26, 1980. Edited by R. F. Hill. Washington, DC, Government Institutes, Inc., 1980. 1600 p. $45.

Papers were presented on energy policy, including U.S. energy policy, world energy use, and Mexican, Canadian, and European energy perspectives. Topics were discussed in energy analysis, planning, and regulation, and effective energy use was examined in terms of energy management, cogeneration, energy efficient buildings, heat recovery systems, and solar sources and heat pumps. Specific attention was paid to energy saving methods for combustion heat sources, electric and advanced automobile engines, and synfuels programs. Fuel cells were investigated, along with prospects and problems in nuclear electric generation, enhanced oil recovery, and solar passive, thermoelectric, and photovoltaic systems. Finally, OTEC systems were explored, as were specific and regional biomass programs, peat and methane fuels, large wind turbine siting techniques and projects, and present and future solar instrumentation. M.S.K.

A82-14925 Energy technology VIII: New fuels era; Proceedings of the Eighth Conference, Washington, DC, March 9-11, 1981. Edited by R. F. Hill (Bridgeport, University, Bridgeport, CT). Rockville, MD, Government Institutes, Inc., 1981. 1472 p. $48.

Papers were presented on energy analysis, planning, and regulation, noting lead times necessary for energy systems development, the socioeconomic and environmental effects of energy systems, and utility planning procedures. Effective energy use was considered in terms of utility load management, cogeneration, conservation, heat pumps, and heat recovery methods. Technologies for exploitation of fossil, geothermal, and nuclear resources were discussed, with attention given to synthetic fuels, fuel cells, and fusion prospects. Finally renewable energy resources were examined regarding solar building heat systems, economics, solar pond performance, biomass, alcohol, small-scale hydro, wind turbine performance, and photovoltaic systems. M.S.K.

A82-15068 Incorporation and impact of a wind energy conversion system in generation expansion planning. K. F. Schenk and S. Chan (Ottawa, University, Ottawa, Canada). *(Institute of Electrical and Electronics Engineers, Summer Meeting, Portland, OR, July 26-31, 1981.) IEEE Transactions on Power Apparatus and Systems*, vol. PAS-100, Dec. 1981, p. 4710-4718. 7 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada.

A computer model is used to simulate the operation of zero, 75 MW, and 150 MW wind energy conversion systems (WECS) in conjunction with other utility generating sources over a 20 year period. The wind turbines are modelled as multistate processes with an output proportional to wind variability. Cost analyses are reported for each year of simulated operation, and emphasis is placed on optimal generator expansion plans and capacity mix for displacement, fuel savings, and the impact of WECS on capital and operating costs. Attention is also given to the system loss of load probability (LOLP) and capacity reserve margin, along with cash flow and interest during construction; costs of alternatives to WECS (coal, nuclear, hydro, etc.) were also considered. Results include: the total present worth of the 75 MW WECS was greater than that for the 150 MW WECS; the LOLP increases with the 75 MW system and decreases for the 150 MW WECS; and the 75 MW WECS replaces 16.7 GW of energy. The program is judged to be effective in predicting negative energy demand for utilities by use of WECS. M.S.K.

A82-15589 Fuel and energy. J. H. Harker and J. R. Backhurst (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England). London and New York, Academic Press, 1981. 373 p. 400 refs. $50.50.

Sources of energy for human use are reviewed, with consideration given to energy forms, conversion, efficiencies of conversion systems, identification of the sources and resources of energy, and the capabilities for various systems to meet enumerated estimates of energy demands. Primary fuels such as solids (coal), liquids (oil), and natural gas are examined for resource availability and methods of use. Processes to alter the form of primary fuels to form secondary fuels for specific applications are outlined, and methods of testing fuels for suitability are elaborated. Energy conversion with and without combustion is discussed for solar, wind, geothermal, nuclear, and chemical energy systems, and calculations of energy conversion efficiencies and economics are given, including energy conservation and recovery in industry. M.S.K.

A82-15598 Fuel conservation measures in South African airways - A review of activity and a glimpse of future developments.

D. P. du Plooy. *Aeronautical Society of South Africa and South African Institute of Aeronautical Engineers, Journal*, vol. 2, no. 1, 1981, p. 52-57.

Operational, structural, and design features intended as fuel conservation measures for wide-bodied aircraft are discussed. Lower speeds, maximum operational altitude flying, and balanced loading are procedures to save fuel, while maintenance of engine efficiency after rebuild, instrument accuracy, exterior cleanliness, and control surface operational accuracy reduce drag. Modification of the horizontal stabilizer is noted, and attention is given to work on the regenerative engine, advanced airfoils, winglets, and active controls, as well as laminar and natural flow control by using a tandem wing configuration. Suggestions for improvements to air traffic control systems are offered, while the increasing use of diesel fuels in automobile engines is seen as a destabilizing force in the price of jet fuels, and alternate fuels, such as synthetic crude and liquid hydrogen are reviewed. M.S.K.

A82-15665 An energy saving transit concept for new towns. J. E. Anderson (Minnesota, University, Minneapolis, MN). *Journal of Advanced Transportation*, vol. 15, Summer 1981, p. 127-141. 7 refs.

Through study of the equation for energy use per trip it is shown how to choose the characteristics of a transit system in such a way that energy use is a minimum. It is shown that the resulting system also minimizes the general equation for cost per trip, takes very little of the urban land, emits virtually no noise, and, because it is electrically powered, does not directly pollute the air. A new town designed with such a system as the major mover of people and goods could have a much better balance between buildings and parks, the ground level would be pedestrian oriented and would provide an environment much more conducive to higher density living than present automobile-oriented towns, and many more trips could be taken by walking and cycling. The combination provides a high-quality urban environment that would use substantially less energy then that required of auto-oriented towns today. Prospects for commercialization and research and development needs are discussed. (Author)

A82-16199 Dimethyl sulfate in particulate matter from coal- and oil-fired power plants. D. J. Eatough, M. L. Lee, D. W. Later, B. E. Richter, N. L. Eatough, and L. D. Hansen (Brigham Young University, Provo, UT). *Environmental Science and Technology*, vol. 15, Dec. 1981, p. 1502-1506. 9 refs. Research supported by the Electric Power Research Institute and American Cancer Society; Contract No. DE-AC02-80EV-10405.

A82-16272 † Effect of wick dryness on the performance of heat pipes with separate channels (Vliianie peresykhaniia fitilia na rabochie kharakteristiki teplovykh trub s razdel'nymi kanalami). Iu. F. Gerasimov, Iu. E. Dolgirev, and Iu. F. Maidanik (Ural'skii Politekhnicheskii Institut, Sverdlovsk, USSR). *Energetika*, vol. 24, Oct. 1981, p. 68-74. In Russian.

A method which accounts for the effect of wick dryness is proposed for calculating the performance characteristics of heat pipes whose evaporation zone includes a system of longitudinal steam discharge pipes of rectangular cross section. By analyzing the vapor pressure drop in the wick, it is shown that as the wick grows dry, the heat pipe temperature increases. Calculations are found to be in good agreement with experimental results. V.L.

A82-16342 Model calculations of the chemical processes occurring in the plume of a coal-fired power plant. J. F. Meagher and M. Luria (Tennessee Valley Authority, Muscle Shoals, AL). *Atmospheric Environment*, vol. 16, no. 2, 1982, p. 183-195. 21 refs. Research supported by the U.S. Environmental Protection Agency and Tennessee Valley Authority.

Computer simulations of homogeneous gas phase chemical reactions which occur in the plume of a coal-fired power plant, were conducted to investigate the influence of various environmental parameters on the production of secondary pollutants. Under most conditions examined, hydroxyl radicals appeared to be the most important species in the homogeneous conversion of stack gases into secondary pollutants, and the conversion rates calculated for the oxidation of SO2 to SO4(2-) were consistent with those determined experimentally. The concentration and relative properties of NO(x) from the power plant and reactive hydrocarbons from background air were found to determine the plume reactivity, and under typical summer conditions, the hydroxyl radical concentration reached a maximum at a HC/NO(x) ratio of about 20. The presence of ozone bulges under a wide variety of environmental and plant operational conditions was also predicted. D.L.G.

A82-16348 Alternative transportation vehicles for military-base operations. D. A. Freiwald and W. J. Barattino (Los Alamos National Laboratory, Los Alamos, NM). *International Journal of Hydrogen Energy*, vol. 6, no. 6, 1981, p. 631-636.

It is noted that heretofore little attention has been given by the military services to developing alternatives to gasoline and diesel-fueled ground-transportation vehicles because reliable alternative vehicle technology that could meet military performance requirements was not available. Descriptions are given of two promising types of propulsion systems for military-base vehicles: hydrogen-fueled internal combustion and fuel cell/electric hybrids (methanol or hydrogen fuel cells). It is thought that the military services could be a catalyst in reducing petroleum consumption within the U.S. transportation sector. The principal advantage of the military market is that on each base the organization already exists that is capable of generating and/or distributing an alternative fuel as well as maintaining the vehicle at properly scheduled intervals. C.R.

A82-17076 Energy and ceramics. Edited by P. Vincenzini (CNR, Istituto Statale d'Arte della Ceramica, Faenza, Italy). Amsterdam, Elsevier Scientific Publishing Co. (Materials Science Monographs. Volume 6), 1980. 1310 p. $192.75.

Consideration is given the improvement of energy use efficiency in such ceramic industry processes as the firing of bricks and tiles, through the use of ceramic fiber insulation, progressive kiln aggregates, new kiln furniture designs, new ceramic compositions and additives, and process optimization techniques. Such alternative energy sources as peat, and industrial by-product materials that include fly ash and waste glass are studied, and attention is given the application of silicon carbide, sialon, and silicon nitride to energy production and conversion systems such as adiabatic diesel engines and nuclear reactor components. Also covered are thermoelectric and piezoelectric materials, solar cells, and materials for MHD and other high-temperature applications. O.C.

A82-17281 Fuel conservation now. R. A. Davis (Boeing Commercial Airplane Co., Renton, WA). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 83-95.

Boeing is developing improvements for the existing production run of second generation transports, the 727 and 737 aircraft, in order to meet the escalation of jet transport fuel prices. The improvements include reduction in aircraft weight and aerodynamic drag, engine fuel efficiency, and aircraft operational improvements. Applications of a Kapton lightweight wire insulation was shown to save approximately 386 pounds for each 727 and 170 pounds for each 737. A 1% retrofit table drag reduction package is currently available for the 727. The JT8D 'A' series of engines for the -15 and -17 versions promise specific fuel consumption improvements of 5.5% to be available in 1982. The Performance Data Computer coupled with the full range Autothrottle/Speed Control will provide fuel savings up to 7% for the 727 and up to 6% for the 737. J.F.

A82-17282 Energy savings with today's technology. H. Dibley (British Airways, Heathrow, Middx., England). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 97-133.

The crew of an aircraft seeks to maximize the energy available in the atmosphere and in the aircraft's fuel so as to ensure the efficient and safe operation of a flight. This is accomplished by displaying clear data in front of the crew, by providing the crew with comprehenisve but readily useable information for fuel management (enabling minimum fuel reserves to be carried out), and by relieving

the crew of an unnecessary mental work load to use this information. The optimum profile for minimum fuel use involves (1) climbing with maximum thrust at an optimum speed to optimum cruise altitude for a given aircraft weight and wind gradient; (2) cruise climbing as weight decreases; (3) unrestricted descent to the destination field at optimum descent speed with the idle thrust; and (4) selection of a route which takes advantage of the wind structure to fly the minimum air miles. This can be accomplished by supplying the crew with meteorological information, the fuel flight plan, as well as knowledge of the fuel reserves. A minimum safe altitude display on the pilot's panel is also suggested. J.F.

A82-17289 **Computer flight planning for fuel efficiency.** L. M. Reinkens (Lockheed Aircraft Service Co., Ontario, CA). In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 258-269.

The need to improve fuel efficiency is forcing the aviation industry to reassess the use of computer flight planning (CFP). In the past decade, CFP was based on mechanizing manual techniques; the demand now is for CFP to take technology one step further into (1) inexpensive on-line conversational systems available throughout the world; (2) refined optimization techniques in route and profile selection to minimize fuel uplift, maximize payload, and extend range; (3) reanalysis enroute to reflect take-off variations and minimize fuel consumption; (4) reanalysis in the event of diversion to an alternate; (5) remote data base entry; and (6) refined reserve fuel consumption. The proposed interactive system and conversational network are given; differences in cruise speeds, fuel, and payload requirements of the Boeing 737 and 747 are illustrated. J.F.

A82-17420 **The all-electric airplane - A new trend.** M. J. Cronin (Lockheed-California Co., Burbank, CA). *Lockheed Horizons*, Winter 1981-1982, p. 28-39.

After a brief, historical consideration of the progress of aeronautics and of the feasibility of electrical-propulsion aircraft such as the photovoltaic Solar Challenger, a description is given of the direct operating cost reductions and system efficiencies derived from the replacement of bleed air/hydraulic/pneumatic/electrical aircraft power systems by a single, electric power system. In such a system, electric generators are the sole source of power for such functions as (1) the primary/secondary flight control system; (2) de-icing and anti-icing; (3) environmental controls; (4) electronics and avionics loads; and (5) landing gear actuation and other mechanical functions. Estimates are presented of cycled weight savings and of the power extraction penalties that may be obviated by the all-electric system. The integration of power-by-wire and fly-by-wire systems is also discussed. O.C.

A82-18120 **Energy for the year 2000.** Edited by R. Wilson (Harvard University, Cambridge, MA). New York, Plenum Press (Ettore Majorana International Science Series: Physical Sciences. Volume 6), 1980. 408 p. $42.50.

Possible energy mixes for the U.S. in the 1979-2000 AD time frame are considered. The manufacturing and operational characteristics of photovoltaics are discussed, as are other solar options, such as flat plate collectors, biomass energy production, wind energy conversion systems, and OTEC plants. Attention was given to wave energy conversion and to the role of utilities in the diversification of energy sources. United States energy policy is explored, and various energy scenarios are compared. Breeder reactor technology is detailed, along with reactor safety and the quantitative assessment of risk for reactor safety. Finally, coal conversion is examined, including gasification and fluidized bed technologies. M.S.K.

A82-18643 **Macro-engineering: The rich potential; Proceedings of the Third Symposium, San Francisco, CA, January 6, 1980.** Symposium sponsored by the American Association for the Advancement of Science and American Institute of Aeronautics and Astronautics. Edited by R. Salkeld (System Development Corp., Santa Monica, CA), F. P. Davidson, and C. L. Meador (MIT, Cambridge, MA). New York, American Institute of Aeronautics and Astronautics, 1981. 186 p. Members, $19.; nonmembers, $24.

After considering the relationship of large-scale enterprises to social attitudes and social change, attention is given to: (1) increasing the degree of communication between project-managers and clients in developing countries, (2) the creation of a public-service data utility, and (3) the development of the Great Recycling and Northern Development (GRAND) canal concept for water management on the North American continent. Also discussed are: (4) a solar thermal aerostat research station consisting of a large-diameter, solar-heated sphere capable of stratospheric stationkeeping, (5) a macroengineering solution to the macroproblem posed by the application of solar power satellites to the energy needs of India, (6) a multipurpose microwave space facility for the 1990s, and (7) the disposal of nuclear wastes in space. O.C.

N82-10254# KVB, Inc., Irvine, Calif.
BASELINE DATA ON UTILIZATION OF LOW-GRADE FUELS IN GAS TURBINE APPLICATIONS. VOLUME 3: EMISSIONS EVALUATION Final Report
T. Sonnichsen Jun. 1981 108 p refs Sponsored in part by Electric Power Research Inst.
(EPRI Proj. 1079-3)
(DE81-903764; EPRI-AP-1882-Vol-3) Avail: NTIS HC A06/MF A01

A series of field tests was conducted on two residual-oil-fired gas turbine/heat recovery steam generators (HRSG) comprising a Westinghouse PACE 260-MW combined-cycle unit. Base load emission levels were determined. A series of tests was also made at reduced operating loads. Emission measurements included: (1) gaseous constituents measured by continuous monitoring instrumentation (O2, CO2, NO, NO sub x, and SO2) and by wet chemistry methods (SO3, aldehydes, and chlorides); and (2) particulate characteristics (mass loding, smoke spot number; submicron particle size, and particle morphology). Corrected NO sub x emissions at base load were 170 ppM and 200 ppM with and without HRSG afterburners in service, respectively. The NO sub x emissions decreased with water injection by 50% and were unchanged with the turbine wash. The NO sub x increased with load. DOE

N82-10277# Minnesota Univ., St. Paul. Underground Space Center.
EARTH SHELTER 2. 1979-1980 USC SERIES
1980 236 p refs Presented at the Earth Sheltered Housing Conf. and Exhibition, Minneapolis, 9-11 Apr. 1980; sponsored by the Underground Space Center of the Minnesota Univ. and the Am. Underground Space Association, and Minnesota Soc. Am. Inst. of Architects, and Minnesota Soc. of Professional Eng. Sponsored by DOE
(CONF-800438) Avail: NTIS HC A11/MF A01

Abstracts are presented of 22 conference papers which discuss criteria for constructing earth-sheltered structures for residential and commercial purposes. Aesthetics and the manipulation of form, space, and natural light are examined as well as ionizing radiation levels; legal liabilities in design, construction, and ownership; and the impact of restrictive covenants. The locations and energy conservation efficiency of 80 earth-covered structures in Oklahoma are also examined. A.R.H.

N82-10334# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
INTEGRATION OF DECENTRALIZED GENERATORS WITH THE ELECTRIC POWER GRID
Susan Finger Apr. 1981 193 p refs
(Contract DE-AM01-76EI-02295)
(DE81-029731; MIT-EL-81-011) Avail: NTIS HC A09/MF A01

The economic interactions of customer-owned electrical generators with the central electric power grid was studied. The reciprocal effects of the operation and expansion plans of the utility, and the resulting price of electricity, and the demand patterns and expansion plans of customers are discussed. The system is modeled in an open-loop feedback mode that allows both the utility and the customers to update their plans and expectations for the next time period based on the other's actions in the current time period and based on any new information such as the current time period and based on any new information such as the current price of oil. The utility and the customers solve similar operation and expansion problems, except that each has control over different varisbles. DOE

N82-10506*# DHR, Inc., Washington, D.C.
MARKET ASSESSMENT OF PHOTOVOLTAIC POWER SYSTEMS FOR AGRICULTURAL APPLICATIONS IN MEXICO
William Steigelmann and Itil Asmon (ARD, Inc.) Jul. 1981 135 p refs
(Contracts DEN3-180; DE-AI01-79ET-20485)
(NASA-CR-165441; DOE/NASA/0180-3) Avail: NTIS HC A07/MF A01 CSCL 10A

The first year of cost-competitiveness, the market potential, and the environment in which PV systems would be marketed and employed were examined. Market elements specific to Mexico addressed include: (1) useful applications and estimates of the potential market for PV systems; (2) power requirements and load profiles for applications compatible with PV usage; (3) operating and cost characteristics of power systems that compete against PV; (4) national development goals in rural electrification and rural services, technology programs and government policies that influence the demand for PV in Mexico; (5) financing mechanisms and capital available for PV acquisition; (6) channels for distribution, installation and maintenance of PV systems; and (7) appropriate methods for conducting business in Mexico. A.R.H.

N82-10514# Massachusetts Inst. of Tech., Cambridge.
OESYS: A SIMULATION TOOL FOR NONCONVENTIONAL ENERGY APPLICATIONS ANALYSIS. THEORETICAL AND OPERATIONAL DESCRIPTION WITH USER DOCUMENTATION
Thomas L. Dinwoodie Aug. 1980 190 p refs
(Contract DE-AM01-76EI-02295)
(DE81-029701; MIT-EL-80-022) Avail: NTIS HC A09/MF A01

A method is developed for assessing both the operational and economic performance of variable mixes of energy conversion technologies within their specific service environments. This method is incorporated into OESYS (Optional Energy Systems Simulator), a computer model with the specific capability to assess conditions of economic viability and service reliability for energy project evaluation. The OESYS program is especially well suited to handle stochastic (weather dependent) generation technologies, and simultaneously handles the generation, transfer, and demand of multiple energy quality levels (electricity, high/low grade thermal, liquid/gaseous fuels, etc.). The model can be applied to most use sectors, including residential, commercial, industrial, and institutional, or combinations of use sectors. A model summary description is given. A theoretical description of the types of energy applications handled by OESYS, an operational description of the model, user documentation, and three sample studies are included. DOE

N82-10517# Atlanta Univ., Ga. Dept. of Chemistry.
COOPERATIVE PROGRAM OF APPLIED ENERGY RESEARCH TECHNOLOGY DEVELOPMENT Final Technical Report, 1 Oct. 1979 - 31 Dec. 1980
1980 140 p refs Prepared in cooperation with Georgia Inst. of Technology, Atlanta
(Contract DE-FG05-79ET-60058)
(DE81-028916; DOE/ET-60058/T1) Avail: NTIS HC A07/MF A01

Studies conducted by groups at Atlanta University and the Georgia Institute of Technology Engineering Experiment Station are described. These efforts were proposed as exploratory studies in the area of alternative energy technologies as preliminary work leading to a multi-year program of specific developmental efforts. Topics chosen were supportive of on-going research programs at the two institutions. Work proposed included pertinent literature search, computer modeling, initial choices of systems, and preliminary parametric studies. DOE

N82-10544# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
ENERGY END-USE REQUIREMENTS IN MANUFACTURING, VOLUME 3
F. Krawiec, Dilip R. Limaye (Synergic Resources Corp.), Steve Isser (Synergic Resources Corp.), Roy Beatty (Synergic Resources Corp.), Glenn Colville (Synergic Resources Corp.), and Karen Lang (Synergic Resources Corp.) Jul. 1981 624 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-027976; SERI/TR-733-790R-Vol-3) Avail: NTIS HC A99/MF A01

Data on the US and state manufacturing subsectors' energy end use requirements disaggregated by 2 and 4 digit SIC and temperature level in 1990 are presented. DOE

N82-10551# Science Applications, Inc., La Jolla, Calif.
PROGRAMMER'S MANUAL FOR THE DOEHPE (DOE HEAT PUMP EFFICIENCY) PROGRAM
23 Oct. 1980 78 p refs
(Contract DE-AC03-79CS-10757)
(DE81-769452; SAI-444-80-533-LJ) Avail: NTIS HC A05/MF A01

The computer code DOEHPE, which is used to calculate air source heat pump seasonal and annual performance factors and energy consumption is described. The program computes heating season performance factors, seasonal energy efficiency ratios, representative regional annual performance factors, representative regional annual energy consumption and national energy consumption from the standard measurements of heat pump capacity and power input and heat pump descriptive information as input data. The calculation for single and dual speed compressor heat pumps and single speed compressor heating only heat pumps are described. Representative regional performance factors are computed for each of six major climatic regions shown, for the US, and for each of the standard design heating requirements shown. DOE

N82-10552# Oak Ridge National Lab., Tenn. Energy Div.
ANNUAL CYCLE ENERGY SYSTEM
Robert E. Minturn 1981 6 p refs Presented at the Heat Pump Contractors' Program Integration Meeting, Washington, D.C., 2-4 Jun. 1981
(Contract W-7405-eng-26)
(DE81-024911; CONF-810672-16) Avail: NTIS HC A02/MF A01

The annual cycle energy system (ACES) program which incorporates in a practical system the outstanding energy conservation potential that exists when the unidirectional heat pump and the interseasonal storage of energy are combined to provide heating, cooling, and domestic hot water to buildings is described. Information on the system, its applicability to different geographic areas, and the methodology for designing and building systems are enumerated. It is shown that the system is rugged, reliable, and appreciably more conservative of purchased energy than all practical alternatives. An ACES residential design methodology was also developed. It is concluded that the system is constant in efficiency and capacity during winter operation, independent of extremes in weather, contributes to the reduction of peak demand and increases in daily and seasonal load factors. DOE

N82-10561# Oak Ridge National Lab., Tenn. Energy Div.
WATER-RELATED CONSTRAINTS TO THE DEVELOPMENT OF GEOTHERMAL ELECTRIC GENERATING STATIONS
R. C. Robertson, Alf D. Shepherd, Carey S. Rosemarin, and Michael W. Mayfield Jun 1981 160 p refs
(Contract W-7405-eng-26)
(DE81-025138; ORNL/TM-7718) Avail: NTIS HC A08/MF A01

The water related constraints concerning geothermal energy are discussed. Three different constraints are: (1) water requirements of geothermal power stations; (2) resource characteristics of the most promising hydrothermal areas and regional and local water supply situations; and (3) legal issues confronting potential users of water at geothermal power plants in the states in which the resource areas are located. A total of 25 geothermal resource areas were studied. It is found that each had a hydrothermal resource temperature in excess of 150 C and an estimated 30 year potential of greater than 100-MW(e) capacity. DOE

N82-10562# Montana Dept. of Natural Resources and Conservation, Helena.
MONTANA GEOTHERMAL HANDBOOK: A GUIDE TO AGENCIES, REGULATIONS, PERMITS AND FINANCIAL AIDS FOR GEOTHERMAL DEVELOPMENT
Steven Perlmutter and Jeff Birkby 1980 52 p
(Contract DE-FC07-79ID-12014)
(DE81-024315; DOE/ID-12014/T1) Avail: NTIS HC A04/MF A01

The handbook is divided into three parts: a list of the permits required for various thermal projects, and an estimate of time

needed to obtain them; a brief discussion of the statutes and regulations referred to; and a description of the state and federal grant and loan funding available to a prospective geothermal developer. DOE

N82-10572# KA-Planungs G.m.b.H., Heidelberg (West Germany).
PRELIMINARY INVESTIGATION ON A PRIMARY ENERGY SAVING HEAT SUPPLY SYSTEM FOR THE RESIDENTIAL DISTRICT 'MARIA LINDENHOF' IN DORSTEN, WEST GERMANY Final Report
Alfred Bechtel, Klaus Berlinghoff, Hans Grossmann, Helmut Kaschube, and Friedrich Reinmuth Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 126 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-157; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 26,50

Ways and means to operate a heating station by gas motor-driven heat pumps, using river water as heat source are investigated. The economic viability of the scheme is considered. A comparison with conventional technologies clearly shows the feasibility and effectiveness of this application, and at the same time supplies guidelines for design and dimensioning. Because of possible energy saving, the present investigation supports the realization of the project. Author (ESA)

N82-10573# Renault Vehicles Industriels (France). Direction des Etudes et Recherches.
ENERGY CONSUMPTION AND HEAVY-DUTY VEHICLES [LA CONSOMMATION D'ENERGIE ET LES POIDS LOURDS]
Yves Bonnetain 1980 18 p In FRENCH Presented at S.I.A. Journees Poids Lourds, Paris, 8-9 Oct. 1980
Avail: NTIS HC A02/MF A01

Research and analysis which leads to energy conservation in the operation of tractor-trailers (semis) was reviewed. Two approaches are emphasized: design improvements on the vehicle itself, and policies or dashboard instrumentation which result in a more efficient use of the vehicle. Evidence is presented to show that immediate and significant reductions in fuel consumption are possible merely by instigating more efficient driving practices, e.g., speed laws, governors on engines, etc.
Author (ESA)

N82-10583 Texas Univ. at Dallas.
OIL AND GAS INDUSTRY AND ENVIRONMENTAL POLLUTION: APPLICATION OF SYSTEMS RELIABILITY ANALYSIS FOR THE EVALUATION OF THE STATUS OF ENVIRONMENTAL POLLUTION CONTROL IN THE NIGERIAN PETROLEUM INDUSTRY Ph.D. Thesis
Azhinoto Ozodio Ikpah 1981 377 p
Avail: Univ. Microfilms Order No. 8118224

Current environmental pollution control policies, regulations, oil field management practices and programs for detection, inventory, prevention and control of oil spills/pollution in Nigeria were examined. The status of pollution control in the Nigerian petroleum industry was evaluated. Spill event data which were analyzed based on shore, category, systems, cause/effect relationip, clean-up method, violation and other parameters pertinent to pollution control in the oil industry. Spill data indicated that frequency of spill events is high; dispersant is indiscriminately used; more spills occur onshore; water disposal method is poor; and equipment failure, operators' maintenance error and third party account for a large number of spills. Pipes, valves and gaskets are spill vulnerable components, and the product spilled is generally crude oil. Few spill events were considered violations of federal laws. Standard engineering designs and criteria are employed in production of oil in Nigeria, but the level of investments on strictly pollution control equipments and personnel is minimal. It is concluded that legal and institutional arrangement for pollution control in the Nigerian petroleum industry need modification and updating. Dissert. Abstr.

N82-10585# Oak Ridge National Lab., Tenn. Fossil Energy Information Center.
ENVIRONMENTAL COMPLIANCE PROGRAM HANDBOOK
Aug. 1981 332 p
(Contract W-7405-eng-26)
(DE81-030226; ORNL/EIS-171) Avail: NTIS HC A15/MF A01

Only by demonstrating that energy technologies can be built and operated without adverse environmental impact can these technologies be considered as proven and ready for commercialization by the private sector. This handbook is one of a series covering federal laws and regulations and the laws and regulations of selected states that pertain to air quality, water quality, and the identification and disposal of solid and hazardous wastes. The data summary sheets are part of a computer file. This handbook identifies and provides abstracts to those pertinent laws and regulations which were in force in the State of Ohio in early 1980. The permit forms are those in use during that time frame. T.M.

N82-10586# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
STUDY OF THE FORMATION OF SUBMICRON PARTICULATES GENERATED BY COAL COMBUSTION Quarterly Progress Report, 1 Apr. - 30 Jun. 1981
P. M. Sherman and D. R. Glass Jul. 1981 28 p refs
(Contract DE-FG22-80PC-30305)
(DE81-027447; DOE/PC-30305/T3; QPR-3) Avail: NTIS HC A03/MF A01

The formation of the very small particles was investigated so that combustion and heat transfer conditions which will prevent their formulation can be identified. Emphasis was largely on perfecting techniques for obtaining electron microscope data which can be correlated with variations in heat transfer and combustion parameters. Improvements include better sealing of the furnace tube; provision for measurement of the entire flow field downstream of the flame; better control of the exhaust stream; better control of the coal dust feeder; and better control of the temperature of the secondary air. Program focus on particles in the 50 A to 0.1 micron range. These were largely overlooked in the past because they are difficult to detect. T.M.

N82-10590# Argonne National Lab., Ill.
STUDIES OF THE REGENERATION OF ACTIVATED BAUXITE USED AS GRANULAR SORBENT FOR THE CONTROL OF ALKALI VAPORS FROM HOT FLUE GAS OF COAL COMBUSTION
S. H. D. Lee, S. D. Smith, W. M. Swift, and Irving Johnson May 1981 51 p refs
(Contract W-31-109-eng-38)
(DE81-030192; ANL/CEN/FE-81-1) Avail: NTIS HC A04/MF A01

Regeneration of activated bauxite by water leaching and thermal swing method was studied. It was found that granular activated bauxite was very effective when used as a filter medium in granular bed filters to remove gaseous alkali metal compounds from simulated hot flue gas of PFBC. Activated bauxite that captured alkali chloride vapors easily and effectively regenerated for reuse by a simple water leaching method. Data were obtained on: (1) the leaching rate of the absorbed NaCl; (2) effects on the leaching rate of absorbed NaCl loading, leaching temperature, and the amount of water; and (3) water retention in activated bauxite after leaching. Physical changes and particle attrition of activated bauxite resulting from regeneration are discussed. The sorption mechanisms of activated bauxite toward alkali chloride vapors are interpreted. DOE

N82-10591# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
INEL GOETHERMAL ENVIRONMENTAL PROGRAM Annual Report, 1980
L. S. Cahn, T. L. Thurow, and J. A. Martinez Apr. 1981 73 p refs
(Contract DE-AC07-76ID-01570)
(DE81-025671; EGG-2113) Avail: NTIS HC A04/MF A01

An overview of continuing environmental research and monitoring programs conducted at the Raft River Geothermal Site is provided. The monitoring programs are designed to collect data on the physical, biological and human environments of the development area. Primary research during 1980 emphasized completing baseline studies on terrestrial fauna, establishing an air quality monitoring network, investigating potential sources of fluoride in the Raft River valley, and studying water level changes in the shallow monitor wells in response to development of the geothermal resource. DOE

N82-10592# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

EFFECTS OF ATMOSPHERIC VARIABILITY ON ENERGY UTILIZATION AND CONSERVATION Progress Report, 1 Jan. - 30 Jun. 1981
Elmar R. Reiter, C. C. Burns, H. Cochrane, G. R. Johnson, H. Leong, and J. D. Sheaffer Jul. 1981 99 p refs
(Contract DE-AS02-76EV-01340)
(DE81-026308; DOE/EV-01340/1) Avail: NTIS HC A05/MF A01

The research was focused on four major tasks: planetary wave variability and climate fluctuations; regional energy demand modelling; energy demand modelling for air conditioning; and economic factors in climate-sensitive space-conditioning systems design. Efforts in each of these areas are outlined and described in detail. Predicting the impact of climate variability on energy utilization involves understanding both the mechanisms underlying atmospheric variability and the response of energy demand systems to atmospheric variations. Summary descriptions of significant progress in both areas are presented. DOE

N82-10594# Hart (Fred C.) Associates, Inc., New York, N.Y.
METHODOLOGY FOR DETERMINING THE IMPACT OF ENVIRONMENTAL REGULATORY PROGRAMS Final Report
B. T. Delaney, D. D. Roderique, and T. S. Sekulic May 1981 165 p refs Sponsored by Electric Power Research Inst.
(DE81-903429; EPRI-CS-1834; TPS-79-743) Avail: NTIS HC A08/MF A01

Major federal environmental legislation and regulatory programs affecting the management of air, water, land and solid waste were reviewed. Existing and future environmental regulatory programs and their potential impact on the development and commercialization of advanced, coal-based energy conversion systems are examined. It is determined that the analysis and interpretation of technical information and data collected can be directed towards the development of a methodology by which environmental impacts are systematically reviewed and problem areas identified. DOE

N82-10598# Argonne National Lab., Ill.
ECONOMIC AND ENVIRONMENTAL TRADEOFFS IN COAL CONVERSION
C. D. Livengood, H. S. Huang, and P. S. Farber 1980 20 p refs Presented at the Ann. Meeting of the Air Pollution Control Assoc., Montreal, 22-27 Jun. 1980
(Contract W-31-109-eng-38)
(CONF-800608-8) Avail: NTIS HC A02/MF A01

The costs of environmental control systems and the difficulties of solid waste disposal are discussed. Unless significant cost breakthroughs are achieved, SRC-1 does not appear economically competitive for new large power plants. The use of SRC is favored in plants converting from oil. The recent increased interest in reducing emissions from existing coal fired plants as a control measure for acid rain could open up a significant new market for highly processed coal such as SRC-1. DOE

N82-10599# ECP, Inc., El Segundo, Calif.
CRYSTALLIZED FLY-ASH FEASIBILITY STUDY Final Report
May 1981 78 p refs Sponsored in part by Electric Power Research Inst.
(EPRI Proj. 1210-1)
(EPRI-EL-1836) Avail: NTIS HC A05/MF A01

A study to determine the feasibility for production and use of crystallized fly ash is presented. The raw materials (fly ash, fluxing, nucleating and crystallizing agents), molten state and crystallization analysis and characterization of crystallized fly ash are discussed in detail. The development of the process along with the structural and insulation characteristics of the crystallized fly ash as a mechanical support element for electrical conductors are also described in detail. DOE

N82-10601# Harvard Univ., Cambridge, Mass. School of Government.
RELAXING ENVIRONMENTAL STANDARDS DURING OIL-SUPPLY DISRUPTIONS: PAST, PRESENT AND FUTURE M.A. Thesis
Thomas Hansen Birdsall 13 Apr. 1981 132 p refs
(Contract DE-AC01-80PE-70278)
(DE81-024250; DOE/PE-70278/T15) Avail: NTIS HC A01/MF A01

Relaxation of environmental standards during oil supply disruptions were examined. The following two policy questions are addressed: (1) should environmental standards such as sulfur emissions limitations be relaxed during oil supply disruptions; and (2) if relaxing a particular standard appears desirable, when, where and how should it be relaxed. It is argued that disruptions could suddenly result in marginal pollution abatement costs much greater than the benefits from, or demand for, the marginal improvement in air quality from such abatement, justifying temporary variances. A set of criteria for evaluating variance policies are developed on the basis of both the theoretical rationale for variances and institutional or implementation considerations. Present federal variance policy are described and the criteria are used to evaluate current policy. DOE

N82-10605# Harvard Univ., Cambridge, Mass. School of Government.
CASE STUDIES IN THE APPLICATION OF AIR QUALITY MODELLING IN ENVIRONMENTAL DECISION MAKING: SUMMARY AND RECOMMENDATIONS
Catherine G. Miller May 1981 92 p refs
(Grant EPA-R-805558-01)
(PB81-213233; EPA-600/4-01-034) Avail: NTIS HC A05/MF A01 CSCL 13B

The application of air quality models to examine the problems encountered when trying to use these models in makin environmental policy decisions was undertaken. It is shown that technical and political constraints exist but that unresolved policy issues, the management of the decision process and conflicting institutional and organizational interests also cause problems. Reommendations are made on how to improve the technical planning and management of the decision process so that the air quality models can become a better policy tool within the state of the art, political and organizational constraints. GRA

N82-10606# Geological Survey, Champaign, Ill.
COAL FLY ASH: A REVIEW OF THE LITERATURE AND PROPOSED CLASSIFICATION SYSTEM WITH EMPHASIS ON ENVIRONMENTAL IMPACTS
William R. Roy, Richard G. Thiery (Illinois State Natural History Survey), Rudolph M. Schuller, and John J. Suloway (Illinois State Natural History Survey) Apr. 1981 75 p refs
(PB81-215014; IL/SGS/EGN-98) Avail: NTIS HC A04/MF A01 CSCL 13B

The scientific literature on fly ash generated by coal burning power plants cites is reported. General conclusions are formulated, on the basis of data compiled from this review, on the physiochemical characteristics of the solid waste and the possible environmental impacts of its disposal. GRA

N82-10717# Department of Agriculture, Washington, D.C. National Economics Div.
ENERGY EXPENDITURE AND DIETARY CHANGE
Larry G. Traub and Thomas A. Stucker May 1981 27 p refs
(PB81-218471; AGESS-810512) Avail: NTIS HC A03/MF A01 CSCL 10A

Comparative expenditures for food and costs of energy in the food system under alternative diets was studied. The types of diet analyzed are: the current average diet consumed; and a diet consistent with specifications of the dietary guidelines. It is shown that the greatest savings under a diet altered to conform with the dietary guidelines is in electrical generation, and the least energy savings in refined petroleum use. GRA

N82-11175# Coordinating Research Council, Inc., Atlanta, Ga.
INFORMATIONAL REPORT ON THE MEASUREMENT AND CHARACTERIZATION OF DIESEL EXHAUST EMISSIONS
J. M. Perez, F. J. Hills, D. Schuetzle, and R. L. Williams Dec. 1980 286 p refs
(PB81-221251; CRC-APRAC-CAPI-1-64-517) Avail: NTIS HC A13/MF A01 CSCL 07D

Guidance on selection of methods for collection and analysis of the constituents in diesel exhaust to enable a complete chemical characterization of the exhaust is provided. A thorough review of the state of the art for measuring diesel emissions was prepared. Methods were compiled and their engineering applicability was evaluated. Available methods were reviewed to establish the state of the art. In some cases, sufficient documentation for the use of the method was available in the literature. In other cases, cooperative round-robin testing of the method was conducted

and these findings are reported. The methods allow complete assessment of the constituents that are of current interest in diesel exhaust GRA

N82-11233# Bechtel Corp., San Francisco, Calif.
ALTERNATIVE FUEL FOR THE STEEL INDUSTRY OF NORTHERN INDIANA: A PREFEASIBILITY STUDY OF A CENTRAL COAL GASIFICATION PROJECT
May 1981 275 p refs Sponsored in part by Northern Indiana Public Service Co.
(Contract DE-FG01-80RA-50146)
(DE81-029314; DOE/RA-50146/1) Avail: NTIS HC A12/MF A01

A survey of the demand for natural gas indicates a wide variation, from a low of 220 billion Btu per day to a high of 387 billion Btu per day. After an examination of the market demand, it was concluded that the synthetic fuels plant should be sized to produce 120 billion Btu per day of gas. Due to the costs of installing additional gas distribution systems and modifying fuel burning equipment, it was concluded that a medium Btu gas should be produced that would have special properties to meet the requirements of existing equipment. The Lurgi and Texaco gasification processes were chosen as the basis for the study. The most significant environmental constraint will be air quality. Although the use of either process is feasible, NIPSCO selected the Texaco case for the development of the economics. A cash flow analysis indicates that the price of medium Btu gas required to yield a 15 percent DCF return on equity is $5.87 per million Btu in 1981 dollars. This is approximately equal to the current price of imported oil. It is based on a 20 year financial analysis using a 3:1 debt to equity ratio and assumes an annual escalation in cost and gas price of 10 percent. DOE

N82-11239# TRW, Inc., Redondo Beach, Calif.
LABORATORY STUDY FOR REMOVAL OF ORGANIC SULFUR FROM COAL Final Report
1 Jul. 1981 210 p refs
(Contract DE-AC22-80PC-30141)
(DE81-025132; DOE/PC-30141/T4) Avail: NTIS HC A10/MF A01

A description of laboratory experimental equipment and a detailed discussion of the results is presented. Initial and concluding engineering design and cost estimations are also presented and the last two sections contain recommendations for future work and an appendix of laboratory data. The TRW Gravimelt Process involves the treatment of mine-cleaned coal with molten potassium and or sodium hydroxide to chemically extract both organic and pyritic sulfur into the molten alkali. The coal mineral content is broken down to forms insoluble in water but soluble in a second liquid, usually dilute sulfuric acid. The high density of the melt causes the desulfurized coal to float to the surface, where it is skimmed off. The coal is then washed with water to completely recover the alkali metal and the coal is dried. If the coal is next washed with a second liquid, almost all of the mineral matter is extracted into the solution. DOE

N82-11245# Aerospace Corp., Los Angeles, Calif.
NEAR-TERM GOALS FOR ALCOHOL FUELS FROM BIOMASS: AN OVERVIEW OF RESOURCE REQUIREMENTS, LAND USE, ENVIRONMENTAL, AND SOCIOECONOMIC IMPACTS
J. Halsey, D. Hazard, K. Kawaoka, K. Stephens, and G. DAlessio (DOE) Argonne, Ill. Argonne Natl. Lab. Dec. 1980 111 p refs
(Contract W-31-109-eng-38)
(DE81-029987; ANL/EES-TM-149) Avail: NTIS HC A06/MF A01

The biomass resources needed to meet national alcohol production goals are examined, available technologies for utilizing agricultural products and byproducts are reviewed, and potential environmental and socioeconomic impacts of near-term alcohol production are identified. Near-term (1985 to 1986) land resource requirements and impacts are emphasized with particular attention to the major corn producing states. Results indicate that: (1) the grain availability for ethanol production does not appear to be limiting for these near-term production capacity goals; (2) major expension of acreage planted in corn should not result from these goals; (3) environmental impacts on and from farm lands should not increase significantly; (4) food prices may increase due to the near-term goals, but farmers should benefit overall; and (5) the expansion of alcohol production in the longer term (1986 to 2000 and beyond) will necessitate the use of additional biomass feedstocks and residues. DOE

N82-11249# International Science and Technology Inst., Inc., Washington, D. C.
ASSESSMENT OF OIL-SHALE TECHNOLOGY IN BRAZIL Final Technical Report, 27 Oct. 1980 - 27 Jul. 1981
27 Jul. 1981 143 p refs
(Contract DE-AC01-80ER-30010)
(DE81-027574; DOE/ER-30010/1) Avail: NTIS HC A07/MF A01

This assessment investigates whether US oil shale developers might benefit from the experience gained by the Brazilians in the operation of their Usina Prototipo do Irati oil shale demonstration plant at Sao Mateus do Sul, and from the data generated from their oil shale research and development programs. A chapter providing background information on Brazil and the Brazilian oil shale deposits is followed by an examination of the potential recovery processes applicable to Brazilian oil shale. The evolution of the Brazilian retorting system is reviewed and compared with the mining and retorting proposed for US shales. Factors impacting on the economics of shale oil production in Brazil are reviewed and compared to economic analyses of oil shale production in the US. Chapters examining the consequences of shale development in terms of impact on the physical environment and the oil shale worker complete the report. DOE

N82-11252# Department of Energy, Oak Ridge, Tenn.
SOLVENT-REFINED COAL-1 DEMONSTRATION PROJECT. FINAL ENVIRONMENTAL IMPACT STATEMENT, VOLUME 1 OF 2 Final Report
Jul. 1981 700 p refs
(DE81-025983; DOE/EIS-0073-Vol-1) Avail: NTIS HC A99/MF A01

The potential environmental impacts associated with the construction and operation of a 6000-tpsd-capacity coal liquefaction facility at Newman, Kentucky which will demonstrate the technical operability, economic viability, and environmental acceptability of an SRC-I process are assessed. Impacts assessed include the following: effects of the project on occupational and public health resulting from the production and use of SRC products; potential impacts on terrestrial and aquatic ecology; potential and expected impacts on land use; withdrawal and alteration of prime agricultural land; projected effects on flood-plain and wetland areas; potential impacts on surface water and groundwater; potential impacts on ambient air quality; potential change of the cultural landscape; potential impacts on sites of archaeological significance; and changes to existing economic and social characteristics of the site area. Long-range and cumulative impacts of a future commercial expansion of the proposed facility at the proposed site to an approximately 30,000-tpsd capacity are also addressed. A construction and operational monitoring plan to assess the effectiveness of the planned mitigatory measures for the duration of the demonstration phase is presented. DOE

N82-11263# California Univ., Livermore. Lawrence Livermore Lab.
POSSIBLE USE OF COAL IN HAWAII, 1980 - 2000
R. B. Bell 12 Feb. 1981 52 p refs
(Contract W-7405-eng-48)
(DE81-028266; UCRL-53121) Avail: NTIS HC A04/MF A01

The possibilities for the use of coal in the State of Hawaii are explored. The nature of the Hawaiian energy sector, the possible role coal could play in that sector, and some of the costs and consequences of introducing coal into the State are addressed. The technical issues connected with coal use are presented. DOE

N82-11265# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ALCOHOL FUELS IN THE UNITED STATES
R. R. Stiger 1981 12 p refs Presented at tht Am. Nucl. Soc. Ann. Meeting, Miami Beach, Fla., 7 Jun. 1981
(Contract DE-AC07-76ID-01570)
(DE81-026013; CONF-810606-75) Avail: NTIS HC A02/MF A01

An overview of the social and technical issues surrounding the production of alcohol for fuels is presented. A brief analysis of the United States Alcohol Program is followed by a discussion of technical and economic factors that affect the production of alcohol fuels. DOE

N82-11270# Water Resources Council, Washington, D.C.
COAL LIQUEFACTION DEMONSTRATION PLANT NEAR MORGANTOWN, WEST VIRGINIA: WATER ASSESSMENT REPORT Summary Report
21 Aug. 1980 14 p refs Prepared in cooperation with Ohio River Basin Commission
(PB81-216103) Avail: NTIS HC A02/MF A01 CSCL 08H

A preliminary assessment of the commercial project as currently planned is presented. Topics covered include the need for water management policies for the Ohio River Basin to regulate water distribution, as well as a pollution monitoring system. GRA

N82-11273# Research Triangle Inst., Research Triangle Park, N. C.
COAL GASIFIER PARAMETERS INFLUENCING ENVIRONMENTAL POLLUTANT PRODUCTION
D. A. Green, J. G. Cleland, D. P. Daugherty, W. J. McMichael, F. O. Mixon, and R. S. Truesdale Jun. 1981 95 p refs
(Grant EPA-R-804979)
(PB81-221301; RTI/1934/00-03F; EPA-600/7-81-098) Avail: NTIS HC A05/MF A01 CSCL 21D

A series of fixed-bed coal gasification and pyrolysis tests were performed in a laboratory scale reactor of 6.6 cm inside diameter. Chemical analyses were conducted on the product gas, the aqueous condensate, the tar, and the solid residue from the tests. The effects of process variables, such as feed mode, catalytic treatment, pressure, mesh size, and coal type, upon byproduct and pollutant yields are described. The production of gaseous sulfur compounds, benezene and derivatives (BTX), phenolics (phenol, cresols, and xylenols), and tar were measured, and the fate of trace elements such as arsenic, selenium, and lead were determined. Byproduct production associated with the pyrolysis phase of gasification was investigated with emphasis on the effects of particle size, residence time, and atmosphere. Continuous operation was found to result in greatly reduced tar and phenolic production. GRA

N82-11274# TRW, Inc., McLean, Va. Energy Systems Group.
ENVIRONMENTAL RESEARCH PLAN FOR GAS SUPPLY TECHNOLOGIES. VOLUME 2: ENVIRONMENTAL RESEARCH PLAN Final Report
L. M. Tipton 29 May 1981 168 p refs 2 Vol.
(Contract GR1-5080-351-0316)
(PB81-222317; GRI-80/0013.2) Avail: NTIS HC A08/MF A01 CSCL 21D

Federal environmental regulations affecting gas supply technologies are reviewed. The technological and environmental state of the art of each gas supply technology was analyzed with the help of a series of experts, in gas supply technology. Based on regulatory requirements technology status, and current environmental knowledge, the environmental issues associated with each technology area were identified. Environmental research being performed by government, industry and educational institutions was identified by computerized literature search and reviewed applicability recommended research activities for GRI funding were developed and a suitable prioritization methodology was devised. GRA

N82-11275# Cornell Univ., Ithaca, N. Y.
ETHANOL PRODUCTION IN SOUTHERN TIER EAST REGION OF NEW YORK: TECHNICAL AND ECONOMIC FEASIBILITY Final Report
Robert J. Kalter Mar. 1981 348 p refs Sponsored by New York State Energy Research and Development Authority
(PB81-226979; Rept-81-7; NYSERDA-81-7) Avail: NTIS HC A15/MF A01 CSCL 07A

This is the third of five region-specific feasibility studies on regional production of ethanol. It was found that deproteinized whey resources in this region of New York could support ethanol production in amounts ranging from about 1.5 million to 5 million gallons a year while also producing a high-protein, high-mineral animal feed. Ethanol is an octane booster which can be used as a gasoline extender to produce gashol. GRA

N82-11276# Missouri River Basin Commission, Omaha, Nebr.
SYNTHETIC FUEL DEVELOPMENT FOR THE UPPER MISSOURI RIVER BASIN. SECTION 13: WATER ASSESSMENT REPORT
Apr. 1981 129 p refs Sponsored in part by the Water Resources Council
(PB81-224537) Avail: NTIS HC A07/MF A01 CSCL 21D

The results of an assessment of water requirements, water supply availability and other water implication of synthetic fuel development in the Upper Missouri River Basin are summarized. The availability of water to support certain hypothetical levels of synfuel development for three types of coal conversion technologies is determined. The major effects that synfuel development could have on the water resources of the region are identified. GRA

N82-11310*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN OPTIMIZATION MODEL FOR ENERGY GENERATION AND DISTRIBUTION IN A DYNAMIC FACILITY c81
F. L. Lansing *In its* The Telecommun. and Data Acquisition Rept. 15 Oct. 1981 p 206-222 refs

Avail: NTIS HC A11/MF A01 CSCL 05A

An analytical model is described using linear programming for the optimum generation and distribution of energy demands among competing energy resources and different economic criteria. The model, which will be used as a general engineering tool in the analysis of the Deep Space Network ground facility, considers several essential decisions for better design and operation. The decisions sought for the particular energy application include: the optimum time to build an assembly of elements, inclusion of a storage medium of some type, and the size or capacity of the elements that will minimize the total life-cycle cost over a given number of years. The model, which is structured in multiple time divisions, employ the decomposition principle for large-size matrices, the branch-and-bound method in mixed-integer programming, and the revised simplex technique for efficient and economic computer use. T.M.

N82-11317# Argonne National Lab., Ill.
SITE AND NEIGHBORHOOD DESIGN (SAND): DEVELOPMENT OF SIMPLIFIED AUTOMATED BUILDING THERMAL LOAD PROCEDURES, PHASE 1
G. T. Diderrich and R. A. Hrabak Jul. 1980 116 p refs
(Contract W-31-109-eng-38)
(DE81-027138; ANL/CNSV-TM-68) Avail: NTIS HC A06/MF A01

Preliminary efforts toward the development of simplified procedures for estimating the thermal-loads of buildings are presented. The acquisition implementation, and documentation of the thermal load procedures and associated data files actually used by the five SAND participants are described. DOE

N82-11318# American Society of Heating, Refrigerating and Air-Conditioning Engineers, New York. Subcommittee for Simplified Energy Analysis.
ENERGY ANALYSIS SAMPLE BUILDING DATA
Mar. 1981 34 p refs
(Contract DE-AC01-78CS-20057)
(DE81-027188; DOE/CS-20057/T5) Avail: NTIS HC A03/MF A01

Sample building data for energy calculations necessary for the comparative analysis between the proposed energy calculation procedure and the procedures using comprehensive hourly simulation of HVAC systems are presented. The comparison calculation includes data for the terminal reheat system, double-duct system, heat reclaim system, and standard VAV system for a hypothetical 20-story office building in Washington, DC. Each is evaluated in conjunction with electric centrifugal chiller and gas-fired boiler. DOE

N82-11320# Battelle Pacific Northwest Labs., Richland, Wash.
SAMPLING DESIGN FOR THE 1980 COMMERCIAL AND MULTIFAMILY RESIDENTIAL BUILDING SURVEY
W. M. Bowen, A. R. Olsen, and A. L. Nieves Jun. 1981 98 p
(Contract DE-AC06-76RL-01830)
(DE81-028783; PNL-3883) Avail: NTIS HC A05/MF A01

The extent to which new building design practices comply with the proposed 1980 energy budget levels for commercial and multifamily residential building designs (DEB-80) can be assessed by: (1) identifying small number of building types which account for the majority of commercial buildings constructed in the U.S.A.; (2) conducting a separate survey for each building type; and (3) including only buildings designed during 1980. For each building, the design energy consumption (DEC-80) will be determined by the DOE2.1 computer program. The quantity X = (DEC-80 - DEB-80). These X quantities can then be used to compute sample statistics. Inferences about nationwide compliance with DEB-80 may then be made for each building type. Details of the population, sampling frame, stratification, sample size, and implementation of the sampling plan are provided. DOE

N82-11321# DCS Corp., Washington, D.C.
ASSESSMENT OF BUILDING DIAGNOSTICS
George E. Courville Jul. 1981 118 p refs Prepared for ORNL
(Contract W-7405-eng-26)
(DE81-027078; ORNL/Sub-80/61602/1) Avail: NTIS HC A06/MF A01

The building diagnostics requirements for in-situ or field measurements on energy consumption in conditioned spaces and on heat gain and loss in residential and nonresidential buildings are evaluated. Energy audit programs, energy performance monitoring, energy flow in buildings, and use of computer technology are considered. A diagnostics program is outlined. DOE

N82-11323# National Bureau of Standards, Washington, D.C.
ENERGY ANALYSIS FOR A SAMPLE BUILDING BY THE PROPOSED ASHRAE SIMPLIFIED METHOD
T. Kasuda and K. Ishii Jan. 1981 265 p
(Contract DE-AC01-78CS-20057)
(DE81-027189; DOE/CS-20057/T4) Avail: NTIS HC A12/MF A01

An energy analysis of a sample office building located in Washington, DC using the proposed ASHRAE method is presented. Calculations for space load are presented. The calculations for the energy distribution systems (air conditioning, outdoor air control, humidity control, airduct systems) are given. Equipment system calculations, and calculations for the annual energy consumption for air conditioning are presented. DOE

N82-11376# Department of Energy, Washington, D. C.
ELECTRIC POWER SUPPLY AND DEMAND FOR THE CONTIGUOUS UNITED STATES, 1981 - 1990
Jul. 1981 584 p refs
(DE81-027126; DOE/EP-0022) Avail: NTIS HC A25/MF A01

The outlook for electric power supply and demand in the United States decade 1981 to 1990 is reviewed from the perspective of reliability and adequacy of service. Electric power supply adequacy as projected for the nine Regional Reliability Council areas of the contiguous United States is reported as well as interruptible load data reported by the Councils. Coeneration is discussed. Each of the 27 electric regions (sub-areas of the nine Council areas) in the contiguous US are studied. A glossary of terms is given. Appendices describe the Council structure, and include a copy of the ERA-411 Manual, which contains all the items to which the Councils were asked to respond. The utilities with included data, the Staff Report, Estimated Electric Demand and Supply for Summer 1981, Contiguous United States dated May 1981 are included. DOE

N82-11414# Brookhaven National Lab., Upton, N. Y. Energy Storage and Conversion Div.
CHEMICAL HEAT PUMP PROGRAM: AN OVERVIEW
Alessio Mezzina 1981 5 p Presented at the Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981
(Contract DE-AC02-76CH-00016)
(DE81-025086; BNL-29592; CONF-810672-22) Avail: NTIS HC A02/MF A01

Chemical heat pumps comprise reversible reactions which can be driven by low grade heat. Thermal energy is absorbed in one direction and liberated in the reverse direction; thus, serving as a basis for system designs applicable to space conditioning or process heat management and offering the capability for high density energy storage as an integral part of the system. The program background, rationale, technology, and research and development needs are described. DOE

N82-11418# E-Tech, Inc., Atlanta, Ga.
INVESTIGATION OF DIRECT EXPANSION IN GROUND SOURCE HEAT PUMPS
Mark D. Kalman 1981 6 p refs Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981 Submitted for publication
(Contract W-7405-eng-26)
(DE81-024139; CONF-810672-5) Avail: NTIS HC A02/MF A01

A fully instrumented subscale ground coupled heat pump system was developed, and built, and used to test and obtain data on three different earth heat exchanger configurations under heating conditions (ground cooling). Various refrigerant flow control and compressor protection devices were tested for their applicability to the direct expansion system. Undistributed Earth temperature data were acquired at various depths. The problem of oil return at low evaporator temperatures and low refrigerant velocities was addressed. An analysis was performed to theoretically determine what evaporator temperature can be expected with an isolated ground pipe configuration with given length, pipe size, soil conditions and constant heat load. Technical accomplishments to data are summarized. DOE

N82-11419# Pittsburg Univ., Pa. Dept. of Mechanical Engineering.
WELL-WATER-SOURCE HEAT PUMP FIELD PERFORMANCE STUDY
R. S. Dougall 1981 5 p refs Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981 Submitted for publication
(Contract W-7405-eng-26)
(DE81-024136; CONF-810672-7) Avail: NTIS HC A02/MF A01

Two well-water source heat pumps (WWSHPs) were instaled in two single-family residences in rural south-central Pennsylvania to supply heating in the winter and cooling during the summer. The heat pump installations are being instrumented with an automated data gathering system for evaluating the performance of the systems. The instrumentation and data acquisition system design was completed and a preliminary design of the control logic and data reduction software for the minicomputer to be located at the sites was obtained. DOE

N82-11477# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.
AN EVALUATION OF THREE-WAY CONTROL SINGLE AND DUAL BED CATALYSTS AS APPLIED TO HEAVY-DUTY GASOLINE ENGINES
Thomas Nugent Apr. 1981 30 p refs
(PB81-224982; EPA-AA-SDSB-81-4) Avail: NTIS HC A03/MF A01 CSCL 21G

A test program to evaluate the applicability of three-way control (TWC) and dual-bed catalysts (TWC and Oxidation Catalysts) in combination with a closed-loop control stoichiometric (feedback) carburetor on a production 1978 IHC 404 CID heavy duty gasoline engine was conducted. Testing was conducted according to the Federal test procedure for the heavy-duty transient cycle. The test program consisted of forty-six cold-start tests, fifty-eight confimatory hot-start tests run to insure accuracy and precision of the cold-start tests, and fourteen hot-start tests run to identify the effects of air/fuel ratio control points on NOx emissions. The effects of various combinations of catalysts, EGR, air/fuel control points, carburetor response times and air pump capacity on emissions, fuel economy and engine power were examined. GRA

N82-11479# Environmental Protection Agency, Ann Arbor, Mich. Office of Mobile Source Air Pollution Control.
EPA EVALUATION OF THE FUEL-MAX DEVICE UNDER SECTION 511 OF THE MOTOR VEHICLE INFORMATION AND COST SAVINGS ACT
Edward Anthony Barth Jun. 1981 140 p
(PB81-229866; EPA-AA-TEB-511-81-10A; EPA-AA-TEB-511-81-10B) Avail: NTIS HC A07/MF A01 CSCL 13F

The 'FUEL-MAX' device is an air bleed device that replaces the EGR valve. It is claimed to conserve fuel. The purpose of the EGR system is to control oxides of nitrogen (NOx). Removal of the EGR valve to install the 'FUEL-MAX' disables the EGR system and would be expected to result in a large increase in NOx emissions. Test data submitted by the applicant confirmed this prediction as well as indicating that 'FUEL-MAX' might improve fuel economy. Although the data did no adequately quatify the amount of this improvement, EPA chose to conduct confirmatory testing. GRA

N82-11480# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch.

EPA EVALUATION OF THE AUTOMOTIVE CYLINDER DEACTIVATOR SYSTEM (ACDS) UNDER SECTION 511 OF THE MOTOR VEHICLE INFORMATION AND COST SAVING ACT

Edward Anthony Barth May 1981 99 p
(PB81-228256; EPA-AA-TEB-511-81-7) Avail: NTIS HC A05/MF A01 CSCL 13F

The conclusions of the evaluation of the automotive cylinder deactivator sytem device under provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act are announced. This device is designed to deactivate engine cylinders as a means of increasing a vehicle's fuel economy. GRA

N82-11524# Water Resources Council, Washington, D.C.

GREAT PLAINS GASIFICATION PROJECT, MERCER COUNTY, NORTH DAKOTA; WATER ASSESSMENT REPORT SECTION 13(C)

Dec. 1980 46 p refs Prepared in cooperation with Missouri River Basin Study Group
(PB81-216111) Avail: NTIS HC A03/MF A01 CSCL 08H

The features and location of a project to produce synthetic fuels from a coal gasification plant are described as well as the design of the plant and the support activities, such as mining and reclamation. The availability of the water supply is discussed including competing uses and water rights. The impacts of plant operations on water quantity and quality are assessed for the Missouri and Knife Rivers and for ground water levels. Changes to wetlands are also considered. GRA

N82-11525# Water Resources Council, Washington, D.C.

GREAT PLAINS GASIFICATION PROJECT, MERCER COUNTY, NORTH DAKOTA; WATER ASSESSMENT REPORT

4 Aug. 1980 14 p refs Prepared in cooperation with Missouri River Basin Study Group
(PB81-216129) Avail: NTIS HC A02/MF A01 CSCL 08H

A water assessment of synfuels development in the Upper Missouri River Basin was conducted. Findings assessment show that water supplies are physically available within the mainstream of the Missouri River in North Dakota to supply the requirements of the gasifiction facilities and the supporting activities -- mining and reclamation, electricity, and project-induced population increases. GRA

N82-11535# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Progress Report, Jan. - Mar. 1981

R. vonBriesen, J. E. Tillman, F. C. Paddison, C. S. Leffel, Jr., and S. Kane Apr. 1981 44 p refs
(Contracts DOE-EX-76-A-36-1008; DE-A101-79ET-27025)
(PB81-218141; JHU/APL/EQR/81-1) Avail: NTIS HC A03/MF A01 CSCL 08G

The laboratory is engaged in developing energy resources, utilization concepts, and monitoring and storage methods. The report is divided into three sections. The first, geothermal energy development planning and technical assistance, contains reports on the progress of geothermal related tasks on which effort was concentrated during the quarter. The second section, siting of critical facilities, contains reports on geologic investigations in western Connecticut and areas in adjacent New york, development of seismotectonic domains, and fracture permeability in siting hazardous waste repositories. The third section, energy conservation and storage techniques, reports on institutional barriers to landfill methane recovery and the need for state legislation. T.M.

N82-11574# Oak Ridge National Lab., Tenn. Health and Safety Research Div.

ENERGY ANALYSIS OF HUMAN ECOSYSTEMS IN AN APPALACHIAN COAL COUNTY

A. P. Watson 1980 31 p refs Presented at the Intern. Symp. on the Human Side of Energy, Laramie, Wyo., 7-9 Jul. 1981
(Contract W-7405-eng-26)
(DE81-025177; CONF-8007107-2) Avail: NTIS HC A03/MF A01

Preliminary results from a energy analysis of the coal fuel cycle in an Appalachian coal county has provided systematic assessment of hidden energy subsidies in extraction, transport, processing, and combustion. Current results indicate a major loss due to depletion of the coal resource base by use of inefficient mining techniques. Although of smaller magnitude, reductions in work force and community productivity from occupational accidents and disease and road maintenance requirements for transport also appear to be significant. DOE

N82-11589# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.

MODELING ENERGY-CONSERVATION POTENTIALS OF COMMUNITY ENERGY-SYSTEM TECHNOLOGIES

Peter I. Kleeman 1981 8 p refs Presented at 12th Ann. Pittsburg Conf. on Modeling and Simulation, 30 Apr. - 1 May 1981
(Contract DE-AC02-76CH-00016)
(DE81-026059; BNL-29720; CONF-810477-2) Avail: NTIS HC A02/MF A01

A mathematical model is presented for estimating energy-conservation potentials of community-energy-system technologies in meeting community energy service demands. The model is formulated to identify optimal community composition, technology choices, and fuel use under various fuel price, energy service demand, and other system-parameter assumptions. DOE

N82-11613# Department of Energy, Washington, D. C. Office of Policy, Planning and Analysis.

INTERRELATIONSHIPS OF ENERGY AND THE ECONOMY: A SUPPLEMENT TO THE NATIONAL ENERGY POLICY PLAN REQUIRED BY TITLE VIII OF THE US DEPARTMENT OF ENERGY ORGANIZATION ACT (PUBLIC LAW 95-91)

Jul. 1981 70 p refs
(DE81-027526; DOE/PE-0030) Avail: NTIS HC A04/MF A01

This study developed a fairly wide range of estimates for the impact of energy prices on such key variables as real gross national product, inflation, and the US trade balance. The retrospective analysis suggests that potential economic output in the near future is being affected adversely by such energy price results from the recent past as lower investment, reduced labor force participation, slower growth in labor productivity, and reduced access to real energy resources. Policies that seek to stimulate the supply side of the economy (including policies that seek to stimulate the specific development of energy resources) are directed at offsetting such past effects. 1981-90 projections are presented of the impacts upon the economy in the three energy price scenarios developed in the document Energy Projections to the Year 2000. DOE

N82-11614# Wisconsin Center for Public Policy, Madison.

SOLPLAN REPORT: AN ASSESSMENT OF BARRIERS AND INCENTIVES TO CONSERVATION AND ALTERNATIVE-ENERGY USE IN THE RESIDENTIAL SECTOR IN WISCONSIN

C. K. Fulenwider, Lonnie S. Weiss, Carol Pfefferkorn, Don E. Wiener, and Stephen L. Feldmam Mar. 1981 453 p
(Contract DE-FG02-79CS-30292)
(DOE/CS-30292/3) Avail: NTIS HC A20/MF A01

The Alternative Energy Policy Project of the Wisconsin Center for Public Policy focused upon two principle objectives: gathering the heating industry generally, the alternative-energy industry commercialization; and building consensus around alternative energy policy to develop guidelines for alternative energy policy for the state. Particular attention was paid to public involvement in the policy process and to assessing barriers and incentives from as many key sectors of the energy field as possible. Data were gathered from the general public, alternative energy users, the heating industry generally, the alternative-energy industry specifically, and key decision makers. T.M.

N82-11616# South Carolina Energy Research Inst., Columbia.
RESIDUAL-ENERGY-APPLICATIONS PROGRAM: EAST-FACILITY REQUIREMENTS DOCUMENT
P. W. Yngve and F. H. Zander 31 Jul. 1981 237 p refs
(Contract DE-AC09-77ET-12866)
(DE81-027489; DOE/ET-12866/8-Vol-2) Avail: NTIS HC A11/MF A01

The objectives of the EAST facility are to perform research and development on heat energy recovery and conversion equipment; establish high confidence in system performance, system availability, and system operating, maintenance, and material costs; and provide a national competence in technologies required for the installation and operation of heat recovery systems. Detailed descriptions of seven potential test articles which represent a wide range of types and sizes of heat recovery systems were contained. EAST operations, including test planning, test policies, systems testing, and facility organization and staffing were discussed. Additionally, information is included on a preliminary site analysis for the EAST Facility and other test support system requirements are described. T.M.

N82-11624# State Univ. of New York at Albany.
SITE SELECTION FOR SMALL WIND ENERGY CONVERSION SYSTEMS FOR US DEPARTMENT OF ENERGY FIELD EVALUATION PROGRAM
Bruce H. Bailey Oct. 1980 67 p Sponsored by New York State Energy Research and Development Authority
(PB81-226862; NYSERDA-81-2) Avail: NTIS HC A04/MF A01 CSCL 10A

The site selection procedure followed to locate two qualified sites for the installed and monitoring of two commercially available small wind energy conversion systems as part of the U.S. Department of Energy's Field Evaluation Program is described. The aim of the evaluation program is to gain operating experience with wind systems in actual locations and to identify the siting and operational issues involving wind energy conversion systems. The two sites selected were approved as test sites for the program. GRA

N82-11626# Mitre Corp., McLean, Va. Energy and Resources Div.
US ENERGY STRATEGIES: SOME OPTIONS FOR ELIMINATING OIL IMPORTS BY THE YEAR 2000
Edward G. Sharp, Elaine G. Carlson, Daniel J. Entingh, John J. Fearnsides, Robert P. Foreman, Willard E. Fraize, David Gray, Rodney K. Lay, John G. Leigh, Milton Lytton et al Apr. 1981 23 p refs
(PB81-226052; MTP-81W0002) Avail: NTIS HC A02/MF A01 CSCL 10A

Topic areas discussed include: reasonable choices which eliminate the need for oil imports; potential domestic liquid fuel supplies; capital requirements for increased domestic liquid fuel supplies; potential for reducing liquid fuels demand; and domestic natural gas. Other domestic energy resources and future domestic energy demands are discussed. GRA

N82-11627# National Highway Traffic Safety Administration, Washington, D. C. Technology Assessment Div.
THIRD AUTOMOTIVE FUEL ECONOMY RESEARCH CONTRACTORS COORDINATION MEETING
Charles L. Gauthier, ed. Dec. 1980 777 p refs Proceedings of Conf. held in Washington, D.C., 1-2 Dec. 1980
(PB81-222754) Avail: NTIS HC A99/MF A01 CSCL 10A

Topic areas covered include: industry analyses; driver energy conservation; heavy duty trucks; consumer research and market demand; vehicle weight reduction; and diesel engine studies are presented. Spark ignition engine and drivetrain improvements. GRA

N82-11641# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.
KINETICS OF NO/ SUB X FORMATION DURING EARLY STAGES OF PULVERIZED-COAL COMBUSTION Quarterly Report, 4 Apr. - 30 Jun. 1981
W. V. Krill, E. K. Chu, G. C. Snow, S. Pessagno, and H. Tong 31 Jul. 1981 54 p refs
(Contract DE-AC22-80PC-30295)
(DE81-029071; DOE/PC-30295/3; QR-3) Avail: NTIS HC A04/MF A01

Kinetics of NO/sub x/ formation during early stages of pulverized coal combustion, are reported. The well stirred nature of the reactor gas phase region and coal transport air are verified in cold flow and combustion tests. A single pass trajectory of coal paticles through the stirred region was achieved. Preliminary thermal NO/sub x/ formation characteristics of the gas phase and the reactor temperature environment are measured for use with the kinetic model. DOE

N82-11642# Acurex Corp., Mountain View, Calif.
SURVEY OF PARTICULATE EMISSION MACRO- AND MICRO-SAMPLING AND SIZING METHODS
William O. Lipscomb Feb. 1981 116 p refs
(Contract DE-AC18-80FC-10193)
(DE81-028348; DOE/FC-10193/T1; Acurex-TR-81-01/SR)
Avail: NTIS HC A06/MF A01

Methods for sampling and fractionating flue gas particulates were developed. The survey was composed of three parts: (1) macro methods; (2) micro methods; and (3) real time-monitoring/sizing methods. A survey and cursory evaluation of commercially available macro, micro, and real time measurement systems is presented. It is concluded that macro and micro methods utilizing impactors and cyclones are available. DOE

N82-11644# Argonne National Lab., Ill. Energy and Environmental Systems Div.
SOLID AND HAZARDOUS ENERGY WASTES: SYNFUELS. 1: REVIEW OF RESEARCH ACTIVITIES
L. Fradkin, T. Surles, and W. DeCarlo May 1981 164 p refs Sponsored in part by EPA
(Contract W-31-109-eng-38)
(DE81-028503; ANL/EES-TM-142) Avail: NTIS HC A08/MF A01

Chemical and biological research on solid, liquid, and gaseous waste streams from coal conversion and oil shale technologies is summarized. Brief descriptions, the objectives, current activities, and future plans, of ongoing projects were obtained. References to publications that resulted from the various research projects are included. References to work on hazardous and solid synfuel waste are included in the appendixes. DOE

N82-11646# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
INTERGRATED ASSESSMENT FOR ENERGY-RELATED ENVIRONMENTAL STANDARDS: A SUMMARY OF ISSUES AND FINDINGS
John P. Holdren Oct. 1980 60 p refs
(Contract W-7405-eng-48)
(DE81-028552; LBL-12779) Avail: NTIS HC A04/MF A01

Environmental impacts of energy technologies arise from many stages in the flow of an energy source from discovery to end-use, propagate via disruptions in many media, and manifest themselves as many different undesirable effects. The aim of the investigation is to understand the capacities and limitations of the assessment mechanisms available for use in the formulation of environmental standards applied to energy technologies. T.M.

N82-11651# Lovelace Biomedical and Environmental Research Inst., Albuquerque, N. Mex. Inhalation Toxicology Research Inst.
LOW-BTU-GASIFIER EMISSIONS TOXICOLOGY Status Report, Dec. 1980
R. F. Henderson, ed. Apr. 1981 67 p refs
(Contract DE-AC04-76EV-01013)
(DE81-031000; LMF-85) Avail: NTIS HC A04/MF A01

Inhalation hazards to plant workers and the general population that may be associated with low Btu coal gasification were assessed. To achieve this goal, it is necessary to characterize the potential toxicants in liquid and solid process and waste streams. The experimental low Btu gasifier at METC was sampled to determine aerosol components in gaseous process streams and to assess potential toxicants in liquid and solid effluent streams. T.M.

N82-11652# Arizona Univ., Tucson. Dept. of Mining and Geological Engineering.
SULFUR POLLUTION CONTROL. PHASE 1: THE DISPOSAL PROGRAM Final Report, Sep. 1978 - Jun. 1980
Michael Rieber, Benjamin Okech, and Roger Fuller Jan. 1981 263 p refs

(Contract DI-BM-JO-88144)
(PB81-222612; BM-OFR-94(3)-81) Avail: NTIS HC A12/MF A01; also available in set of 4 reports HC E99 CSCL 07A

Sulfuric acid production from sulfur based acid plants and smelters is analyzed and industry competition, with particular emphasis on voluntary versus abatement acid, is reviewed. Production costs for both acid plants and smelters are estimated. Large scale users prefer sulfur based acid production if the heat value of the reaction is utilized as a steam credit. Voluntary acid is a more stable supply source than smelter acid. Voluntary acid output is a reaction to price and demand conditions. An output forecast is made based on APC regulations, implementation, and estimated metals production. GRA

N82-11654# Exxon Research and Engineering Co., Florham Park, N.J.
CONTROL OF UTILITY BOILER AND GAS TURBINE POLLUTANT EMISSIONS BY COMBUSTION MODIFICATION, PHASE 2 Final Report, Jun. 1978 - Jun. 1979
E. H. Manny and A. R. Crawford Mar. 1981 178 p refs
(Contract EPA-68-02-1415)
(PB81-222267; EPA-600/7-81-039; EE.5E.81) Avail: NTIS HC A09/MF A01 CSCL 13B

The applicability of combustion modification (CM) techniques to control NOx and other pollutant emissions from utility boilers and gas turbines without causing deleterious side effects was studied. Comprehensive, statistically designed tests were used to evaluate the effect of CM. In staged low excess air tests of low-NOx, dual-fired utility boilers, special attention was paid to the determination of potentially adverse side effects; increased combustible emissions, unwanted changes in particulate mass loading and size distribution, reduced boiler efficiency, increased furnace slagging, and tube wall corrosion may be applied to coal fired utility boilers. The extent of furnace tube wall corrosion and slagging could not be determined conclusive. GRA

N82-11655# Arizona Univ., Tucson. Dept. of Mining and Geological Engineering.
SULFUR POLLUTION CONTROL PHASE 1: THE DISPOSAL PROGRAM (SECTIONS 5 THROUGH 7) Final Report
Michael Rieber, Roger Fuller, and Osmario Dellaretti Jan. 1981 190 p refs
(Contract DI-BM-JO-188144)
(PB81-222804; BM-OFR-94(2)-81) Avail: NTIS HC A09/MF A01 CSCL 13B

Sulfur recovery from domestic sour natural gas and petroleum refining on a current basis and projected to the mid-1990's on a regional basis was estimated. The current basis depends importantly on gas production projection for the Overthrust Belt and the associated H2S. The regional basis depends on projected increases in the sulfur content and weight of imported crude oils, total crude oil imports, and anticipated refinery response. GRA

N82-11657# TRW, Inc., McLean, Va. Energy Systems Group.
ENVIRONMENTAL RESEARCH PLAN FOR GAS SUPPLY TECHNOLOGIES. VOLUME 1: EXECUTIVE SUMMARY Final Report
L. M. Tipton and P. D. Junkin 29 May 1981 78 p refs 2 Vol.
(Contract GR1-5080-351-0316)
(PB81-222309; GRI-80/0013.1) Avail: NTIS HC A05/MF A01 CSCL 21D

The environmental impacts and constraints associated with gas supply technologies are summarized. Specific environmental research needs based on state of the art technology and current environmental knowledge are identical. Technologies considered include those producing: unconvential natural gas (tight gas sands, Devoian shale, coalbed methane, and geopressured methane), SNG from coal and peat and SNG from biomass (land based, water based and waste. GRA

N82-11661# Research Triangle Inst., Research Triangle Park, N. C.
VAPOR-PHASE CRACKING AND WET OXIDATION AS POTENTIAL POLLUTANT CONTROL TECHNIQUES FOR COAL GASIFICATION Final Report, Nov. 1978 - Apr. 1981
W. J. McMichael, S. K. Gangwal, D. A. Green, and F. O. Mixon Jun. 1981 58 p refs
(PB81-219594; RTI/1934/00-01F; EPA-600/7-81-096) Avail: NTIS HC A04/MF A01 CSCL 13B

Bench-scale experiments were used to determine rates of hydrocracking and wet oxidation as a function of process conditions and catalyst used. A microreactor system, capable of holding 1.0 cc of material to be screened for catalytic activity, was used in the hydrocracking studies. Benzene and alkylated benzene compounds were used as model compounds in determining the potential of various materials to cracking rates. Thiophene was used as a model compound for catalyst poisoning studies. Cracking rates were determined for coal-derived materials produced from bituminous and subbituminous coals and materials containing iron and nickel compounds. T.M.

N82-11671# Environmental Protection Agency, Las Vegas, Nev. Exposure Assessment Research Div.
GEOTHERMAL ENVIRONMENTAL ASSESSMENT: BEHAVIOR OF SELECTED GEOTHERMAL BRINE CONTAMINANTS IN PLANTS AND SOILS Final Report
K. W. Brown Jun. 1981 36 p refs
(PB81-222333; EPA-600/4-81-052) Avail: NTIS HC A03/MF A01 CSCL 13B

The behavior of selected elements found in the Roosevelt Hot Springs KGRA geothermal fluids was investigated in both plant and soil systems. The kinetics of these potential environmental containments were studied by using soil columns and selected cultivated and native plant species. GRA

N82-11679# PEDCo-Environmental, Inc., Cincinnati, Ohio.
EPA UTILITY FGD (FLUE GAS DESULFURIZATION) SURVEY Quarterly Report, Jan. - Mar. 1981
M. Smith, M. Melia, N. Gregory, and K. Scalf Aug. 1981 308 p refs
(Contract EPA-68-01-6310)
(PB81-225773; EPA-600/7-81-012C) Avail: NTIS HC A14/MF A01 CSCL 13B

Information contributed by the utility industry, process suppliers, regulatory agencies, and consulting engineering firms is summarized. Domestic FGD systems are tabulated alphabetically by development status (operational, under construction, or in planning stages), utility company, process supplier, process and waste disposal practice. Data on boiler design, FGD system design, fuel characteristics, and actual performance are presented. Unit by unit dependendability parameters, and problems and solutions associated with the boiler and FGD systems are discussed. Process flow diagrams and FGD system economic data are also presented. T.M.

N82-11680 Maryland Univ., College Park.
SELECTED STUDIES OF FOUR HIGH-TEMPERATURE AIR-POLLUTION SOURCES Ph.D. Thesis
Mark Steven Germani 1980 406 p
Avail: Univ. Microfilms Order No. 8121096

The atmospheric emissions of five copper smelters, a coal-fired power plant, a municipal incinerator and the Mt. Erebus volcano in Antarctica were examined. Many chalcophilic elements, e.g., As, Se, Pb, Cd, Zn, W and In, are strongly enriched with respect to the Earth's crustal abundance pattern in particulate material emitted from copper smelters. Vapor-phase concentrations of several elements in a high temperature gas stream and tested at a coal-fired power plant were determined and compared with those from a municipal incinerator. The results from the coal-fired power plant and incinerator indicate that 5-10 times more Hg is emitted from the power plant. Particulate and vapor-Erebus show large enrichments for many elements, most notably the volatile chalcophilic elements, As, Se, In, Cd and Sb, and the halogens, F, Cl and Br. About 95% of the Cl, 24% of the As and > 90% of the F are present in the vapor phase. High concentrations of F are present in the lava lake as evidenced by the ratio of Cl to F found in the vapor-phase samples. Dissert. Abstr.

N82-11712# California Univ., Livermore. Lawrence Livermore Lab.
COMPUTER MODELS TO SUPPORT INVESTIGATIONS OF SURFACE SUBSIDENCE AND ASSOCIATED GROUND MOTION INDUCED BY UNDERGROUND COAL GASIFICATION

R. T. Langland and B. C. Trent (Science Applications, Inc., Steamboat Springs, Colo.) 1981 14 p refs Presented at the 7th Ann. Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 8-11 Sep. 1981
(Contract W-7405-eng-48)
(DE81-027131; UCRL-86437; CONF-810923-1) Avail: NTIS HC A02/MF A01

Two computer codes compare surface subsidence induced by underground coal gasification at Hoe Creek, Wyoming, and Centralia, Washington. Calculations with the STEALTH explicit finite-difference code are shown to match equivalent implicit finite-elemet method solutions or the removal of underground material. Effects of removing roof material, varying elastic constants, investigating thermal shrinkage, and burning multiple coal seams are studied. A coupled finite-difference continuum rigid-block caving code is used to model underground opening behavior. Numerical techniques agree qualitatively with empiricial studies but, so far, underpredict ground surface displacement. The two methods, numerical and empirical, are most effective when used together. It is recommended that the thermal characteristics of coal measure rock be investigated and that additional calculations be carried out to longer times so that cooling influences can be modeled. DOE

N82-11731# Massachusetts Inst. of Tech., Cambridge.
OCEANS AND OCEAN CURRENTS: THEIR INFLUENCE ON CLIMATE
Reginald E. Newell, Long S. Chiu, Wesley Ebisuzaki, Alfredo Navato, and Henry B. Selkirk 1980 56 p refs Presented at the Conf. on Climate and Offshore Energy Resources, London, 21 Oct. 1980 Sponsored in part by the National Science Foundation, Washington, D.C.
(Contract DE-AS02-76EV-12195)
(DE81-027263; DOE/EV-12195/41; CONF-8010198-2) Avail: NTIS HC A04/MF A01

Particular attention is given to influences that may be related to offshore energy generation. The role of the ocean currents and seasonal, as well as nonseasonal variations, are discussed. The effects of the Southern Oscillation, a non-seasonal signal in the climate system second only to the Ice Ages, are emphasized. T.M.

N82-11985# PEDCo-Environmental, Inc., Cincinnati, Ohio.
FGDIS PRIMER: MAJOR EQUIPMENT/COMPONENT CLASSIFICATIONS, PROBLEM/SOLUTION ACCESS CODES, AND DEFINITIONS RELATED TO FGD SYSTEMS AS CONTAINED IN THE FLUE GAS DESULFURIZATION INFORMATION SYSTEM (FGDIS)
May 1981 135 p
(Contract EPA-68-02-3173)
(PB81-225948) Avail: NTIS HC A07/MF A01 CSCL 05B

The major equipment and component classification used in the Flue Gas Desulfurization Information system is presented. Such things as the problem and solution codes used in conjunction with the FGD system performance data, as well as definitions of common terminology used to describe FGD systems and power plants in geneal are included. Along with the classifications of the various complex equipment items and components that comprise FGD systems, brief functional descriptions and illustrations are provided. GRA

N82-11988# Los Alamos Scientific Lab., N. Mex.
NATIONAL COAL-MARKET CONDITIONS FOR THE YEAR 2000: REGIONAL-ISSUE IDENTIFICATION AND ANALYSIS, HIGH SCENARIO
Frank Wolak Jul. 1981 18 p refs
(Contract W-7405-eng-36)
(DE81-026425; LA-8906-MS) Avail: NTIS HC A02/MF A01

Coal market data inputs necessary to operate the model used for the solid-waste impacts of coal-fired electricity production are described. The ROCKY3 model generated minemouth prices and quantities produced for each coal type from each coal supply region and the delivered price and quantity to each coal consumption region of each coal type from all of the coal supply regions. DOE

N82-11994*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EVALUATION OF THE MICRO-CARBURETOR
Merkel F. Weiss, Robert A. Hall, and Steven D. Mazor Aug. 1981 83 p refs
(Contracts NAS7-100; DE-AI01-79CS-50080)
(NASA-CR-164958; JPL-Pub-81-75) Avail: NTIS HC A05/MF A01 CSCL 13F

A prototype sonic, variable-venturi automotive carburetor was evaluated for its effects on vehicle performance, fuel economy, and exhaust emissions. A 350 CID Chevrolet Impala vehicle was tested on a chassis dynamometer over the 1975 Federal Test Procedure, urban driving cycle. The Micro-carburetor was tested and compared with stock and modified-stock engine configurations. Subsequently, the test vehicle's performance characteristics were examined with the stock carburetor and again with the Micro-carburetor in a series of on-road driveability tests. The test engine was then removed from the vehicle and installed on an engine dynamometer. Engine tests were conducted to compare the fuel economy, thermal efficiency, and cylinder-to-cylinder mixture distribution of the Micro-carburetor to that of the stock configuration. Test results show increases in thermal efficiency and improvements in fuel economy at all test conditions. Improve fuel/air mixture preparation is implied from the information presented. Further improvements in fuel economy and exhaust emissions are possible through a detailed recalibration of the Micro-carburetor. Author

N82-11995# California Univ., Berkeley. Lawrence Berkeley Lab.
URBAN ECOSYSTEM AND RESOURCE-CONSERVING URBANISM IN THIRD WORLD CITIES
R. L. Meier, Sam Berman, Tim Campbell, and Chris Fitzgerald Mar. 1981 195 p refs
(Contract W-7405-eng-48)
(DE81-029854; LBL-12640) Avail: NTIS HC A09/MF A01

A comprehensive overview based on urban ecosystems was employed in field studies of representative cities in developing regions. The rising overall demand of cities in the developing regions was examined with emphasis on petroleum and caloric foodstuffs. Policies necessary to conserve energy and to adapt to increased costs and the possibility of food and water shortages are addressed. DOE

N82-12204# Starck (Hermann C.) Berlin, Goslar (West Germany). Werk Goslar.
DEVELOPMENT OF A PROCESS FOR RECOVERY OF VALUABLE COMPONENTS FROM COMPLEX HYDRODESULFURIZATION CATALYSTS ESPECIALLY TUNGSTEN, MOLYBDENUM, VANADIUM, NICKEL AND COBALT Final Report
Bruno Krismer, Hans-Georg Nadler, and Hartmut Pungs Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 20 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-186; ISSN-0340-7608) Avail: NTIS HC A02/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 4,20

For the nonpolluting recovery of the valuable components W, Mo, Co, Ni and V from complex hydrodesulfurization catalyst residues, an economical process was developed in which the valuable elements are reduced out by carbothermal reactions in the electric arc furnace as a first process step. The metal obtained is ground, roasted, and the oxides are dissolved in a combined acid-base dissolving process. The valuable elements are separated by liquid-liquid extraction steps which make it possible to isolate the valuable materials in the desired grade of chemical purity. Author (ESA)

N82-12205# Ruhrchemie A.G., Oberhausen (West Germany). Abt. Umweltschutz.
THERMAL PROCESSING OF USED CATALYSTS Final Report
Dieter Ernst and Sebastian Speth Bonn Bundesministerium fuer Forschung Technologie Dec. 1980 24 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-189; ISSN-0340-7608) Avail: NTIS HC A02/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 5,05

A preliminary treatment of the used catalysts following fluidized bed thermal processing is presented. It is possible to obtain a starting material free from organic impurities, which is suited to the usual recovery of the valuable components of the

catalysts. In the course of the operation optimization, it was possible to successfully complete the feeding of the fluidized bed reactor with used catalysts from widely varying sources. The waste gas purification and fine dust separation comply with emission regulations. The unit is to be regarded as a demonstration plant, especially if waste heat utilization can be integrated to improve economic performance. Author (ESA)

N82-12278# Aerospace Corp., El Segundo, Calif. Energy and Resource Div.

SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB): REQUIREMENTS DEFINITION AND IMPACT ANALYSIS-2. VOLUME 1: ENERGY-CONSERVING DESIGN FOR RESIDENTIAL STRUCTURES

C. K. Cretcher Nov. 1980 140 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 553-2)
(DE82-900206; EPRI-EM-1506-Vol-1) Avail: NTIS HC A07/MF A01

The impact of stringent energy conserving building standards on electric utility service areas and their customers was analyzed. The demands on the seven broadly representative electric utilities were aggregated to represent the total new construction electric heating demands in the years 1990 and 2000 to be compared to the aggregate obtained similarly for a nominal, less stringent standard, viz., ASHRAE 90-75. Results presented include the percentage of energy savings achieved in both heating and cooling seasons and typical demand profile changes. A utility economic impact analysis was performed for the cases investigated to determine changes in operating costs and potential capacity sales. A third cost component considered is the incremental cost of superinsulation (over ASHRAE 90-75) to the customer. The aggregate net cost to the utility/customer entity is utilized as a measure of overall economic benefit. DOE

N82-12280# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

COMPARISON OF RESIDENTIAL WINDOW DISTRIBUTIONS AND EFFECTS OF MASS AND INSULATION

M. Hannifan, C. Christensen, and R. Perkins Jul. 1981 7 p refs Presented at the 6th National Passive Solar Conf., Portland, Oreg. 8-12 Sep. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-027938; SERI/TP-721-1300; CONF-810925-9) Avail: NTIS HC A02/MF A01

The energy requirements and comfort implications of various window distributions and window areas (representing conventional, sun-tempered, and passive solar designs) are investigated for single-family residences in Albuquerque, NM, Denver, CO, and Madison, WI. Three distinct mass levels ranging from lightweight to heavyweight interiors and three distinct insulations levels, including energy-conserving, night-insulated, and superinsulated cases, are analyzed. Energy requirements are reported for residences with electric resistance heating and mechanical air conditioning. Comfort conditions reported are based on interior average air temperatures and mean-squared errors. DOE

N82-12403# Weiss Technik G.m.b.H., Reiskirchen (West Germany).

PRACTICAL DEMONSTRATION OF HEAT PUMPS FOR UTILIZATION OF ANIMAL-GENERATED HEAT Final Report

Hans-Ulrich Amberg Bonn Bundesministerium fuer Forschung und Technologie Sep. 1980 47 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-100; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10.30

Airconditioning of pigpens to eliminate effects of temperature extremes is reported. A stall air conditioner was installed as heat pump in a pigpen for final fattening. The heat, recovered from the exhaust air, is supplied to the outside air so that heated fresh air is blown into the stall. The test was accomplished on a farm with intensive pig breeding with 120 preliminary fattening places and 240 final fattening places. The stall air conditioner offers the possibility to attenuate the extreme temperature variations during the year. Author (ESA)

N82-12404# Escher Wiss G.m.b.H., Ravensburg (West Germany). Abt. Papiermaschinen.

AIR CIRCUIT WITH HEATING PUMP Final Report

Herbert Holik, Hans Joachim Bauder, Hubert Brugger, Anton Reinhart, and Karl-Heinz Spott Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 56 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-188; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11.80

A pump which draws energy from exhaust air from a paper drying process to heat up the blow air was studied. The use of a heat pump instead of a steam heated exchanger can reduce primary energy consumption for blown air heating by more than half and the costs for air heating up to half. The amortization times for the heat pump extend from 5 to 10 years. Since in the pulp and paper industry, amortization times of less than two years are required for such relatively small investments, the heat pump so far is only used to heat blown air under highly favorable conditions. The rising energy prices shorten the heat pump amortization time. The 100% fuel price increase brought the heat pump with diesel engine drive already to very favorable amortization times of 2 to 5 years. A 20% increase will make the heat pump economically advantageous with an amortization time between 1 and 2 years. Author (ESA)

N82-12424# Unitex Corp., Salt Lake City, Utah.

HIGH-TEMPERATURE COUNTER-FLOW RECUPERATOR Final Report

F. Rudloff May 1981 324 p refs
(Contract DE-AC07-80ID-12077)
(DE81-031923; DOE/CS-12077/T1) Avail: NTIS HC A14/MF A01

The commercial potential of a helical recuperator design in recovering waste heat from industrial furnaces is reported. The helical recuperator concept consists of a cylindrical column with an interior helical interface which separates the preheat air and the combustion gas. The column operates in a tear flow mode and is formed from modular sections. The material evaluation consisted of exposing material samples to a soda-lime glass furnace environment for a fifteen week period. ECP-3, X-81, and Unichrome were the best suited for use in a soda-lime environment and ECP-3 was the best candidate with respect to manufacturing. Two potential design modifications were identified: a finned design and a double helix design. For materials that showed the greatest potential for use in the glass environment, the double helix design made from ECP-3 was the most economical producing payback periods of 6 to 14 years. DOE

N82-12513# Washington Univ., Seattle.

CHEMICAL AND GEOCHEMICAL STUDIES OFF THE COAST OF WASHINGTON Progress Report, Sep. 1980 - Jul. 1981

R. Carpenter, comp. Jul. 1981 14 p refs
(DE81-030319; DOE/EV-70024/44) Avail: NTIS HC A02/MF A01

A series of marine chemical and geochemical investigations involving both laboratory studies and field studies off the coast of Washington is addressed. Most of the field work was on the Washington continental shelf, slope, and the submarine canyons indenting the shelf north of the Columbia River. The aim is to provide basic data required to characterize underlying chemical and physical processes and their rates which control the distributions, concentrations, and ultimate fate of some of the potentially hazardous agents associated with fossil fuel and/or nuclear power production or transportation. Laboratory and field experiments and theories derived from are used iteratively to investigate: (1) vertical transfer of trace chemicals from surface seawaters to underlying waters and sediments; (2) processes which may transfer certain chemicals from sediments back into the overlying water column; (3) redox processes which besides changing valence states of certain chemicals may alter their precipitation/dissolution tendencies, their biological availability and/or toxicity; and (4) accumulation histories of potentially hazardous chemicals in sediments during the past 100 years. DOE

N82-12521# Skelly and Loy, Harrisburg, Pa.

FEASIBILITY ANALYSIS OF TRENCH STRIP AND AUGER MINING Summary Report

Jun. 1981 209 p refs
(Contract DE-AC01-79ET-11268)
(DE81-027557; DOE/ET-11268/14) Avail: NTIS HC A10/MF A01

The feasibility of using Trench Strip and Auger Mining as a means to extract coal reserves which are presently considered uneconomical to mine or which would present undesirable environmental effects if extracted using conventional surface mining methods is assessed. The conclusion is that Trench Strip and Auger Mining, when used as a primary mining system, is a viable alternative to conventional surface mining. Economically, a savings in the selling price of at least $12 per ton (from $28 to $16) can be realized with this concept. Environmentally, the amount of surface area disturbed can be reduced to half, and the amount of overburden handled can be reduced to one-seventh that of a conventional mine. It was also discovered that the trench mine gave similar results on certain surface minable sites that are economically and environmentally sound. DOE

N82-12578# Department of Energy, Washington, D. C. Assistant Administrator for Applied Analysis.
ANALYSIS REPORT: APPLIED ANALYSIS MODEL SUMMARIES
Dec. 1980 173 p
(DE81-029278; DOE/EIA-0293) Avail: NTIS HC A08/MF A01

Brief statements of each model's purpose are presented. Information on the models' characteristics, uses, and requirements is provided and sources for additional information are reported. T.M.

N82-12579# Department of Energy, Washington, D. C.
DEPARTMENT OF ENERGY PROJECTS Quarterly Status Report
30 Jun. 1981 525 p
(DE82-000038; DOE/MA-0006/2) Avail: NTIS HC A22/MF A01

The report is designed to provide Department of Energy (DOE) management with a summary of the important baseline data that exists in the DOE project data base. This data base is maintained chiefly from periodic field management reports required by DOE Order 5700.4. Since most of the current estimates in this report are from field project managers, they do not necessarily have full headquarters approval. The current budget data sheet estimates that appear in the report are considered appropriate for reporting external to the Department. DOE

N82-12580# Data Resources, Inc., Lexington, Mass.
MODELS FOR FORECASTING ENERGY USE IN THE US FARM SECTOR Final Report
L. R. Christensen Electric Power Research Inst. Jul. 1981 200 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 682-1)
(DE81-904220; EPRI-EA-1956-Vol-1) Avail: NTIS HC A09/MF A01

Econometric models were developed and estimated for the purpose of forecasting electricity and petroleum demand in US agriculture. A structural approach is pursued which takes account of the fact that the quantity demanded of any one input is a decision made in conjunction with other input decisions. Three different functional forms of varying degrees of complexity are specified for the structural cost function, which describes the cost of production as a function of the level of output and factor prices. Demand for materials (all purchased inputs) is derived from these models. A separate model which break this demand up into demand for the four components of materials is used to produce forecasts of electricity and petroleum is a stepwise manner. DOE

N82-12581# Merix Corp., Wellesley, Mass.
ENERGY CONSERVATION IN DISTILLATION Final Report
T. W. Mix, J. S. Dweck, M. Weinberg, and R. C. Armstrong Jul. 1981 299 p refs
(Contract DE-AC07-78CS-40259)
(DE81-028650; DOE/CS-40259/1) Avail: NTIS HC A13/MF A01

An audit of major industrial and processes and key colums in each major process indicated that approximately twoquads of energy were consumed for distillation in the US in 1976. Energy usage by industry is included: petroleum refineries, 68% chemical (including petrochemical) industry, 29% natural gas liquids processing, 5%. Techniques and current practices for conserving distillation energy are reviewed, and guidelines indicating those process conditons which favor the use of each energy conserving technique are enumerated. Expressions for payout time for tray and control retrofit options are developed based on energy savings and increased throughput. Calculations for industrial colums suggested that both types of retrofits would frequently have short (.6 months) payout times based on either criterion. Extractive distillation is also discussed, and criteria enabling the estimation of the energy which may be conserved using this technique are developed. Good housekeeping practices and field techniques for checking the energy efficiency of industrial distillations are also discussed. DOE

N82-12582# Prototech, Inc., Newton Highlands, Mass.
ENERGY SAVINGS BY MEANS OF FUEL-CELL ELECTRODES IN ELECTRO-CHEMICAL INDUSTRIES Progress Report, 1 Feb. - 30 Apr. 1981
A. Bar-Ilan, Walter Juda, and Brian P. Finnigan 31 Jul. 1981 26 p refs
(Contract DE-AC02-78ET-25309)
(DE81-030975; DOE/ET-25309/T1; COO-4881-31) Avail: NTIS HC A03/MF A01

Life testing of palladium-loaded and low platinum-loaded anodes on type C supports and with type no. 01 current collectors was continued and terminated. Additional life-test data are reported for high Pt-loaded and a second low Pt-loaded anode. The 6 in. x 6 in. depth cell was operated at reduced hydrogen back pressures, and the effect of the resulting flooding of the hydrogen chamber upon cell performance was determined. Furthermore, two 6 in. x 6 in. depth cells were fabricated from the same type platinum support and current collector, but following different preparation procedures. Cell performance was compared at various submergence depths under identical operating conditions. DOE

N82-12583# Los Alamos Technical Associates, Inc., N. Mex.
THE SEVERITY OF INSTITUTIONAL BARRIERS AFFECTING ENERGY-FROM-MUNICIPAL-WASTE TECHNOLOGIES
G. E. Dials, J. M. Greenwood, L. L. Lewis, and E. M. Cole Jun. 1981 58 p refs Presented at Inst. Barriers Assessment Workshop, Washington, D.C., 19 Feb. 1981 Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE82-000133; ANL/CNSV-TM-79) Avail: NTIS HC A04/MF A01

The results from a workshop during which EMW experts were asked to indicate the importance of these barriers are summarized. The basic results of the workshop participants' scoring of the institutional barriers according to their importance are described. More elaborate analyses conducted on the workshop results are reported. A summary of the workshop results and a listing of the most important EMW technology/institutional barrier combinations are included. T.M.

N82-12587# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ASSESSMENT OF THE POTENTIAL OF COAL-FUELED HEAT ENGINES IN TOTAL AND INTEGRATED ENERGY SYSTEMS
J. C. Bratis, M. L. Jain, and T. J. Marciniak Jun. 1981 80 p refs
(Contract W-31-109-eng-38)
(DE82-000169; ANL/FE-81-56) Avail: NTIS HC A05/MF A01

The potential of several prime movers, especially those that use coal, for use in total and integrated energy systems in the residential and commercial sector was investigated. The prime movers considered are diesels, Stirlings, internally and externally fired gas turbines, and steam turbines. Total energy systems based on the prime movers are compared to the conventional system for four communities that represent different ratios of residential to commercial area. The energy savings, environmental effects, and economic benefits are shown. It is found that for both scenarios, neither coal nor oil using total energy systems have a definite economic advantage. DOE

N82-12589# Department of Energy, Washington, D. C. Industrial Data Systems Div.
NATIONAL INTERIM ENERGY-CONSUMPTION SURVEY:

EXPLORING THE VARIABILITY IN ENERGY CONSUMPTION
Robert Latta, Thomas H. Woteki, Lynda Carlson, Wendel Thompson, and Kenneth Vagts Jul. 1981 70 p refs
(DE81-029910; DOE/EIA-0272) Avail: NTIS HC A04/MF A01

The variation in total energy consumption and consumption by end use are described. The report concentrates on regression models for describing the variability in natural gas and electricity consumption for households living in single family detached houses. Sample data and the subsets used in the analyses are described. A theoretical model for describing a household's energy consumption is presented. Graphical summaries of the data which serve to explain the specific models fit to the data are also presented. The empirical models fit to the data, and the method of fitting, are discussed. Results, speculation on interpretation of the model coefficients, and potential uses of the model are summarized. DOE

N82-12593# Rocket Research Corp., Redmond, Wash.
UTILIZATION OF WASTE HEAT FROM MAJOR TRANSFORMER SUBSTATIONS. VOLUME 1: GENERIC STUDY Final Report
N. T. Christensen Aug. 1981 190 p refs Sponsored by Electric Power Research Inst. 2 Vol.
(EPRI Proj. 1274-1)
(DE81-904212; EPRI-EM-1968-Vol-1) Avail: NTIS HC A09/MF A01

Large substation transformers reject substantial thermal energy. Since these units are usually close-coupled to facilities requiring low-temperature thermal energy for space conditioning, the ability to recover and efficiently utilize this energy is of significant interest. The intent of this project was to analytically evaluate the technical and economic potential of transformer waste heat recovery and utilization and verify the analysis with subscale testing. A general system was designed and optimized for the recovery of transformer waste heat. Simplified analytical techniques were developed to assist utilities in both preliminary analysis and detail design analysis of specific systems, including system economics. Critical component performance parameters were identified for the preparation of detailed specifications. Criteria was established for the specific application of such systems through system economics. A national mail survey was conducted to determine the quantity and usability of transformer waste heat in the United States. DOE

N82-12594# Rocket Research Corp., Redmond, Wash.
UTILIZATION OF WASTE HEAT FROM MAJOR TRANSFORMER SUBSTATIONS. VOLUME 2: SITE-SPECIFIC STUDY Final Report
N. T. Christensen Aug. 1981 93 p Sponsored by Electric Power Research Inst. 2 Vol.
(EPRI Proj. 1274-1)
(DE81-904236; EPRI-EM-1968-Vol-2) Avail: NTIS HC A05/MF A01

The applicability of transformer waste heat utilization was examined by analyzing a site-specific application. The site is located in Seattle, Washington; the energy source is the Broad Street Substation and the energy user is the Pacific Science Center. A description of the system is presented in Section I. A preliminary heat source/heat service analysis is given in Section II. Transformer waste heat availability and system heat demand, the thermal performance and hydraulic analysis, overall system efficiency, operation flexibility, major component selection, and the thermal storage system are discussed. The substation site, the transmission system, and the retrofit of the Pacific Science Center are described. System cost details and a cash flow projection are given. DOE

N82-12597# Commission of the European Communities, Luxembourg.
APPLICATION OF DIFFERENT KFA-MODELS IN THE FRAMEWORK OF THE ENERGY RESEARCH PROGRAMME OF THE EUROPEAN COMMUNITIES Final Report
1980 98 p refs
(EUR-6758-EN) Avail: NTIS HC A05/MF A01

Four West German energy models are presented: (1) an energy policy to decrease dependence on oil and gas imports, (2) fuel parameters of various nuclear power plant systems, (3) investments in environmental protection inthe energy sector and their effects on the gross national product, and (4) the use of FORTRAN in modular dynamic simulation. N.W.

N82-12604# Mid-American Solar Energy Complex, Minneapolis, Minn.
WOOD RESOURCES AND UTILIZATION PATTERNS IN THE NORTH CENTRAL REGION AND ENERGY NEEDS FOR THE MANUFACTURE OF WOOD PRODUCTS
Steven A. Sinclair Mar. 1981 37 p refs
(Contract DE-AC02-79-CS-30150)
(DE81-030356; MASEC/R-81-005) Avail: NTIS HC A03/MF A01

The resources of the region are discussed on a state-by-state basis. The discussion of standing timber growth and removal is in terms of commercial growing stock; however, the total forest biomass may be estimated by simply adding the potential logging residue to the growing stock figure. The energy needs of various wood and paper products, plants, standard industrial classification codes 24 and 26, are highlighted. In addition, the ability of various wood manufacturing facilities to generate their energy needs from wood residues and by-products is explored. T.M.

N82-12613# Systems Technology Corp., Xenia, Ohio.
CONVERSION OF MUNICIPAL SOLID WASTE TO ENERGY, JACKSONVILLE, FLORIDA, PHASE 1
Jul. 1981 237 p refs
(Contract DE-AC01-79CS-0231)
(DE82-000808; DOE/CS-20231/1) Avail: NTIS HC A11/MF A01

The development of new technology and to foster the commercialization of innovative concepts for energy recovery from municipal solid waste (MSW) was studied. A program to implement the Scientific energy engineering auger combustion system was evaluated. The commercial version of the system, with a capacity of 350 TPD, was developed. The evaluation of applying resource recovery involved the determination of: (1) the amount and characteristics of solid waste; (2) the location and requirement of candidate energy customers and materials markets; (3) the applicable incineration/heat recovery and resource recovery technologies; and (4) the institutional, legal, and environmental requirements for constructing a facility. An implementation plan is developed to define the specific steps required to employ a waste to energy technology. DOE

N82-12621# Gersham, Brickner and Bratton, Inc., Washington, D.C.
WASTE-TO-ENERGY SYSTEMS INSTITUTIONAL BARRIERS ASSESSMENT WORKSHOP
Jun. 1981 57 p Workshop Held in Washington, D.C., 19 Feb. 1981 Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE82-000098; ANL/CNSV-TM-78) Avail: NTIS HC A04/MF A01

Nontechnical institutional barriers affecting implementation of the waste to energy technology, prioriztion, of identifed barriers, and utilization of information and data to formulate an institutional research plarr, were identified. The following important results are recorded for commercialized and noncommercialized combustor, siting existing laws, multipurisdictional ination, permiles and regulations, and the lack of data on environmental impacts. DOE

N82-12635# Gilbert Associates, Inc., Reading, Pa.
MODULAR HYDRO DAM APPROACH TO THE ECONOMIC DEVELOPMENT OF ULTRA LOW-HEAD HYDROPOWER
K. R. Broome 1981 19 p Presented at the Hydropower Conf., Washington, D.C., 22 Jun. 1981
(Contract DE-AC07-76ID-01570)
(DE81-027817; CONF-8106137) Avail: NTIS HC A02/MF A01

The potential for developing economical new ultra low head sites using an innovative concept known as the modular hydro dam (MHD) were explored. This concept, combines the benefits of shop fabrication and installation of equipment in truck transportable, waterproof power modules, with prefabricated gate sections that can be located between the power modules. The technical, economic, environmental, and institutional feasibility of the MHD concept are examined. Capital and operating costs are estimated. It is concluded that the potential for power generation at ultralow head sites justifies the development of the MHD concept. DOE

N82-12636# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
DOE SMALL-HYDROPOWER DEMONSTRATION PROGRAM
B. N. Rinehart and L. E. Felton Jun. 1981 15 p refs Presented at Waterpower 1981 Conf., Washington, D.C., 22 Jun. 1981
(Contract DE-AC07-76ID-01570)
(DE81-027819; CONF-8106137-2) Avail: NTIS HC A02/MF A01

Hydroelectric power demonstration projects were developed at small dams. The project methods and results are presented.
S.L.

N82-12637# Brookhaven National Lab., Upton, N. Y. Div. of Energy and Economic Analysis.
MODELLING ENERGY-ECONOMIC INTERACTIONS IN DEVELOPING COUNTRIES: A LINEAR-PROGRAMMING APPROACH
Peter Meier and Vinod Mubayi 1981 51 p refs Presented at the 9th Intern. Conf. on Operational Res., Hamburg, 23 Jul. 1981; sponsored by International Federation of Operations Research Societies
(Contract DE-AC02-76CH-00016)
(DE81-026048; BNL-29747; CONF-810726-2) Avail: NTIS HC A04/MF A01

An energy economic assessment model for application to energy assessments in developing countries is described. A simple comprehensive treatment of the energy sector is emphasized. The input output model is directly incorporated in the Energy system LP. The major supply sectors, as well as the major energy using industries, are modelled as capacity expansion problems, in which explicit distinction is made between capital stock and energy flows. For most developing countries the notion of energy supply curves is far fetched, since energy prices are set by planning authority, not established by market clearing equilibrium.
DOE

N82-12641# Audi NSU Auto Union A.G., Neckarsulm (West Germany). Entwicklung Neckarsulm.
FUEL SAVINGS IN HOT WATER HEATING PLANTS BY APPLICATION OF HEAT PUMPS OPERATED WITH NATURAL GAS (NATURAL GAS HEAT PUMP). PROJECT: GAS ENGINE Final Report
Klaus Wissler Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 61 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-125; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11.60

Energy consumption in residential heating using a heat pump driven by an internal combustion engine is discussed. A natural gas rotary engine was developed as a drive unit for a heat pump with 120 to 150 kW heating capacity. The engine was derived from an automotive prototype engine; it had an output of 50 kW at 6000 rpm. The efficiency was improved by an increased compression ratio and a rotor recess suitable for natural gas operation. The engine used specially developed spark plugs and high performance lubrication oil. To obtain longevity, the trochoid surface and the side housing surface were coated with a plasma spray wear coating, ceramic apex seals were used and the accessories were redesigned.
Author (ESA)

N82-12650 California Univ., Los Angeles.
A COMPUTER SIMULATION MODELING STUDY TO PREDICT AIR QUALITY IMPACTS FROM A 500 MW COAL-FIRED POWER PLANT Ph.D. Thesis
Gary Van Jandegian 1981 255 p
Avail: Univ. Microfilms Order No. 8120979

A computer simulation modeling study was conducted to predict sulfur dioxide ambient air quality impacts resulting from the operation of a 500 megawatt coal-fired power plant expansion in the Trombay area of Bombay, India. The AQUAL, a multiple source Gaussian plume dispersion model employs diffusion coefficients and plume rise equations and predicts maximum and average 3 hour and 24 hour ground level pollutant concentrations for up to 250 receptor points within 20 kilometers of a power plant stack(s). Results of the modeling exercises are used to recommend proper SO2 controls such as flue gas desulfurization, fuel switching to low sulfur oil and natural gas, etc.
Dissert. Abstr.

N82-12657*# Mechanical Technology, Inc., Latham, N. Y.
ELECTRIC AND HYBRID VEHICLES ENVIRONMENTAL CONTROL SUBSYSTEM STUDY Final Technical Report
15 May 1981 288 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955682)
(NASA-CR-164995; JPL-9950-570; MTI-81TR36) Avail: NTIS HC A13/MF A01 CSCL 13B

An environmental control subsystem (ECS) in the passenger compartment of electric and hybrid vehicles is studied. Various methods of obtaining the desired temperature control for the battery pack is also studied. The functional requirements of ECS equipment is defined. Following categorization by methodology, technology availability and risk, all viable ECS concepts are evaluated. Each is assessed independently for benefits versus risk, as well as for its feasibility to short, intermediate and long term product development. Selection of the preferred concept is made against these requirements, as well as the study's major goal of providing safe, highly efficient and thermally confortable ECS equipment.
S.L.

N82-12658*# TRW, Inc., McLean, Va. Energy Systems Planning Div.
ELECTRIC AND HYBRID VEHICLE ENVIRONMENTAL CONTROL SUBSYSTEM STUDY Final Report
Kenneth L. Heitner 4 Dec. 1980 198 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955683)
(NASA-CR-164996; JPL-9950-569; Rept-97649-E005-UX-02) Avail: NTIS HC A09/MF A01 CSCL 13B

An environmental control s baystem (ECS) in electric and hybrid vehicles is studied. A combination of a combustion heater and gasoline engine (Otto cycle) driven vapor compression air conditioner is selected. The combustion heater, the small gasoline engine, and the vapor compression air conditioner are commercially available. These technologies have good cost and performance characteristics. The cost for this ECS is relatively close to the cost of current ECS's. Its effect on the vehicle's propulsion battery is minimal and the ECS size and weight do not have significant impact on the vehicle's range.
S.L.

N82-12660# Aerospace Corp., Germantown, Md.
ENERGY TECHNOLOGIES AND THE ENVIRONMENT. ENVIRONMENTAL INFORMATION HANDBOOK
Jun. 1981 515 p refs
(Contract DE-AT03-76EV-74010)
(DE81-029809; DOE/EP-0026) Avail: NTIS HC A22/MF A01

Information on the environmental consequences of energy technologies that will be in use during the next 20 years are reviewed. Information on environmental issues, control technologies, and energy production and conservation processes is discussed. References are given for the statements, data, and conclusions. Environmental aspects of energy technologies and references that can be relied upon through changing policies and changing world energy prices are presented.
DOE

N82-12661# Biosssay Systems Corp., Woburn, Mass.
DEVELOPMENT OF TESTING PROCEDURES AND BIBLIOGRAPHIC INFORMATION RELEVANT TO THE TESTING OF SOLID WASTES RESULTING FROM SYNTHETIC FUELS PRODUCTION Progress Report, 1 Apr. - 30 Jun. 1981
J. M. Smith and D. M. Hanson Jun. 1981 17 p refs
(Contract DE-AC22-80PC-30098)
(DE81-030822; DOE/PC-30098/T2) Avail: NTIS HC A02/MF A01

The data tables outlining which biossay procedures were applied to various synfuel wastes were finalized. Justification for each of the assays (Health and Ecological Effects) proposed in the test battery were written. In addition, the extraction and assay schedules were developed for Task 3.
DOE

N82-12667# Energy and Environmental Analysis, Inc., Arlington, Va.
IMPACT OF FUEL-ECONOMY SHORTFALL: TRENDS IN TECHNOLOGY-WEIGHTED EPA VERSUS ON-ROAD MPG. PERIODIC ANALYSIS MEMORANDUM NO. 1

1 Apr. 1981 23 p refs
(Contract DE-AC01-79PE-70032)
(DE81-030841; DOE/PE-70032/T1) Avail: NTIS HC A02/MF A01

The fuel consumption impacts of revised estimates of the shortfall between the EPA-measured and on-road fuel economy of light-duty vehicles (passenger cars and light-duty trucks less than 8500 lbs GVW) are examined. The analysis uses the DOE Highway Fuel Consumption model to project fuel demand. The technologies and technology-specific shortfall relations are examined. The procedure used to develop aggregate technology-weighted fuel economy shortfall relations for the Highway Fuel Consumption model is outlined. The fuel demand impacts of alternative assumptions regarding technology-specific shortfall are compared. DOE

N82-12671# Aerospace Corp., Germantown, Md.
TECHNOLOGY CHARACTERIZATIONS: ENVIRONMENTAL INFORMATION HANDBOOK, SECOND EDITION
Jun. 1981 340 p refs
(Contracts DE-AT03-76EV-74010; DE-AC01-81EV-10450)
(DE81-029993; DOE/EP-0028) Avail: NTIS HC A15/MF A01

Environmental characterization information for a range of energy supply systems is presented. Environmental residuals and physical resource requirements are the principal information provided. The specific energy technologies included are nuclear, petroleum, natural gas, synthetic fuels, coal, solar, geothermal, and hydroelectric. Each technology is characterized in terms of the resources required, costs, residuals released, energy products, and occupational safety and health data. The information is based on a facility of particular size and design, with the data presented on the basis of annual quantities or total facility lifetime quantities (e.g., construction materials), as appropriate. In addition, the data are normalized to 1 trillion Btu energy output to facilitate cross technology comparison and use of the data in computerized data bases. DOE

N82-12673# Bioassay Systems Corp., Woburn, Mass.
DEVELOPMENT OF TESTING PROCEDURES AND BIBLIOGRAPHIC INFORMATION RELEVANT TO THE TESTING OF SOLID WASTES RESULTING FROM SYNTHETIC-FUELS PRODUCTION Technical Progress Report, 30 Dec. 1980 - 31 Mar. 1981
James M. Smith and Douglas M. Hanson Mar. 1981 25 p refs
(Contract DE-AC22-80PC-30098)
(DE81-030671; DOE/PC-30098/T1) Avail: NTIS HC A02/MF A01

A bibliography containing over 80 references on material pertinent to the biological testing of snyfuel products is presented along with a compedium of information on bioassays performed on all synfual materials within the last ten years. A sample preparation procedure useful in extracting substances for bioassay testing and a bioassay test battery suitable for testing synfuel solid wastes are described. DOE

N82-12674# Oak Ridge National Lab., Tenn. Chemical Technology Div.
KINETICS OF WET OXIDATION OF BIOLOGICAL SLUDGES FROM COAL-CONVERSION WASTEWATER TREATMENT
R. K. Helling, M. K. Strobel, and R. J. Torres Sep. 1981 55 p refs
(Contract W-7405-eng-26)
(DE82-000525; ORNL/MIT-332) Avail: NTIS HC A04/MF A01

Combustible organics in aqueous solutions or suspensions, which are characteristic of waste aqueous solutions or suspensions, which are characteristics of waste treatment effluent from coal liquefaction, may be treatable by wet oxidation. The wet oxidation of model compounds (phenol in water, or phenol in municipal waste sludge) in a batch autoclave reactor was found to proceed rapidly to 99% conversion in less than 15 min for temperatures between 185 and 230OC, oxygen pressures between 2000 and 1300 psig, and initial phenol concentrations of 2.5, 10, and 50 g/L. The reaction occurs in three phases: a slow induction period, a fast first-order reaction with a low activation energy of 4.9 kcal/gmol, followed by a slow first-order reaction. During the reaction a variety of colored intermediates (catechol, succinic acid, hydroquinine) form. It is postulated that the fast portion of the reaction sequence follows free-radical mechanism. DOE

N82-12675# Zawadzki (Edward A.) Ltd., McMurray, Pa.
PRELIMINARY STUDY: USE OF LOW-SULFUR COAL AND COAL CLEANING IN CONTROL OF ACID RAIN
May 1981 38 p
(Contract DE-AC21-80MC-14784)
(DE81-028930; DOE/MC-14784/T1) Avail: NTIS HC A03/MF A01

The acid rain problem and the feasibility of various control techniques are addressed. Two strategies that are proposed for control of acid rain, are considered, (1) use of naturally occurring low-sulfur coal; and (2) cleaning of raw coal in preparation plants prior to firing. The distribution and ownership of the US coal reserves are discussed with emphasis on the reserves having low sulfur content. Some of the basic constraints on the availability and use of low-sulfur coals by utilities are enumerated. A preliminary estimate of the sulfur reduction potential of US coals achievable by coal preparation is presented. Also included are a brief analysis of coal cleaning costs and the effects of coal cleaning on other aspects of acid rain control. DOE

N82-12680# New Mexico State Univ., Las Cruces.
ASSESSMENT OF WATER SUPPLY CONTAMINATION DUE TO UNDERGROUND COAL GASIFICATION
Thomas M. Niemczyk and Edward A. Walters Dec. 1980 105 p refs Prepared in cooperation with New Mexico Univ., Albuquerque.
(PB81-209215; WRRI-128; W81-03269;
OWRT-B-061-NMEX(1)) Avail: NTIS HC A06/MF A01 CSCL 13B

The potential for pollution by metal ions of groundwater as a consequence of proposed underground coal gasification was assessed focusing on subbituminous coal of the San Juan Basin in northwestern New Mexico. Baseline results for major and trace metal analysis of groundwater and minerals, anionic analyses, and trace organic analyses of groundwater are presented. GRA

N82-12765# Oak Ridge National Lab., Tenn.
OVERVIEW OF THE BIOMEDICAL AND ENVIRONMENTAL PROGRAMS AT THE OAK RIDGE NATIONAL LABORATORY
H. A. Pfuderer, comp. and J. B. Moody, comp. Jul. 1981 62 p
(Contract W-7405-eng-26)
(DE81-027864; ORNL-5806) Avail: NTIS HC A04/MF A01

Biomedical and environmental research, to provide information on environmental, health, and safety considerations, which can be utilized in the formulation and implementation of energy technology decisions is discussed. Information for the understanding of short term and long term consequences of processes in new energy technologies were researched. The mechanisms responsible for biological and ecological damage caused by substances associated with energy production and repair mechanisms are investigated. DOE

N82-12766# Texas A&M Univ., College Station. Dept. of Chemistry, Medical Microbiology and Immunology.
IDENTIFICATION AND TOXICITY OF FRACTIONATED-SHALE-OIL COMPONENTS
K. Wittnebel, D. C. Shelly, C.-N. Ho, I. M. Warner, and J. M. Quarles 1981 17 p refs
(Contract DE-AS05-80EV-10404)
(DE81-028460; DOE/EV-10404/T1) Avail: NTIS HC A02/MF A01

A procedure for the separation and identification of polynuclear aromatic hydrocarbons (PNAs) is presented. This procedure comprises two steps. First, the shale oil is separated into fractions according to ring size on a Chromosorb LC-9 normal phase column. Then each of these fractions are separated into individual components and identified using an analytical reversed-phase Ultrasphere ODS 5 micrometer column. In addition, toxicity studies are carried out on each fraction obtained from the amine column to indicate which class of PNAs warrants special attention and analysis. The results of this approach are reported. T.M.

N82-12842# Brookhaven National Lab., Upton, N. Y.
PROJECT IMPACT ANALYSIS AS AN OPTIMAL CONTROL

PROBLEM
G. Anandalingam 1981 43 p refs Presented at the Joint Meeting of the Inst. of Management Sci. and Operations Res. Soc., Toronto, 3-6 May 1981
(Contract DE-AC02-76CH-00016)
(DE81-028466; BNL-29881; CONF-810542-5) Avail: NTIS HC A03/MF A01

The effects of a major investment project on a multi-sector less developed economy are analyzed. Single investment projects with external effects reaching across the entire economy are frequently encountered in developing countries. The Mahaweli Ganga development project in Sri Lanka, a multi-dam irrigation and hydroelectric power project is evaluated. The Mahaweli project calls for an annual investment level, in 1970 prices, of $150 million over a period of six years, which is 50 percent of the annual expenditure of the government. The project requires a large fraction of total investment over a medium term planning period and materially alters the existing supply and demand for major goods and services. The project is sufficiently large that its effect is economy-wide. The model used is a dynamic input-output optimizing model having the mathematical structure of an optimal control problem. DOE

N82-12924# Oak Ridge National Lab., Tenn.
LOW-LEVEL RADIOACTIVE WASTE: AN INTRODUCTORY OVERVIEW
H. W. Godbee and A. H. Kibbey 1981 9 p Presented at the ASME Short Course on Radioactive Waste Management for Nucl. Power Reactors and Other Facilities, Alexandria, Va., 13-17 July, 1981
(Contract W-7405-eng-26)
(DE81-026334; CONF-810733-1) Avail: NTIS HC A02/MF A01

In 1980, the accumulated volume of buried low-level waste (LLW) in the United States amounted to over 92,000 cu m. Of this, 49,700 cu m was attributed to the US commercial fuel cycle, 36,400 cu m to institutional and industrial, and 76,300 cu m to government activities. In addition, there was another 6500 cu m of LLW sent to commercial burial grounds from government agencies or other licensed activities (e.g., fabrication of fuel for foreign reactors). If no more land is licensed for commercial burial, Barnwell with its limited waste acceptance will be the only site still operating in the year 2000. Of the DOE sites, only NTS and Hanford will have ample land. All the other principal DOE sites except LASL will be exhausted and this site will have about 7 of usable land left. DOE

N82-13014# Systems Control, Inc., West Palm Beach, Fla. Technology Industries Div.
ANALYSIS OF INTEGRATED FUEL-EFFICIENT, LOW-NOISE PROCEDURES IN TERMINAL-AREA OPERATIONS
J. B. McKinley Jan. 1981 125 p refs
(Contract DE-AC01-80CS-50141)
(DE81-029833; DOE/CS-50141/T1) Avail: NTIS HC A06/MF A01

The specific aviation energy conservation issues, terminal area fuel conservation and airport noise level relationships, are investigated. The potential fuel savings and noise level reduction in the Los Angeles International (LAX) terminal area between 1980 and 1990 attributable to compliance with the noise requirements of FAR Part 36 were quantified. These savings are due to the retiring, retrofiting and re-engining of older narrow-body aircraft (DC-8, B707, etc.) and the growth of wide body aircraft operations (DC-10, B747, B767, etc.). Current noise abatement procedures that could be relaxed without adversely impacting current (1980) noise levels, and at the same time conserving additional fuel. Two FAA computer models were used. The Integrated Noise Model (INM) Version 2.7, was used for noise analysis, and INKMOD, a preliminary fuel burn model, for the fuel analysis. The results of this detailed analysis revealed that due to the changing aircraft mix at LAX to include more wide body aircraft and fewer narrow body aircraft operations, airport noise level will decrease by 8.5 and 9.2 square miles on the 75 Ldn contour for 1985 and 1990, respectively, from the 1980 baseline. DOE

N82-13018# Corporate-Tech Planning, Inc., Waltham, Mass.
AUGMENTATION OF RESEARCH AND ANALYSIS CAPABILITIES FOR TIMELY SUPPORT OF AUTOMOTIVE FUEL ECONOMY ACTIVITIES. VOLUME 1: SUMMARY Final Report, Dec. 1977 - Nov. 1979
Theodore Taylor, Jr. Dec. 1980 43 p 3 Vol.
(Contract DOT-HS-7-01789)
(PB81-219479; DOT-HS-805903) Avail: NTIS HC A03/MF A01; also available in set of 3 reports HC E15 as PB81-219461 CSCL 13F

A series of research tasks were undertaken to assess the potential fuel economy improvements for passenger cars and light trucks during the 1980 to 1985 time frame, and later to 1990. Specific subject areas of investigation include: spark ignition engine improvements; fuel economy potential of alternate engines; reductions in tire rolling resistance, aerodynamic drag, and engine friction (through improved lubricants); weight reduction of domestic and certain import passenger vehicles, including a teardown of a Chrysler - Dodge Omni for an analysis of materials and weight and a technology assessment of carbon composites as a future substitute materials. Manufacturing and consumer costs for the fuel economy improvement areas identified, identification of unregulated diesel emission problem areas in need of research and a determination of the cost benefits of petroleum conservation by means other than fuel economy standards are included. GRA

N82-13019# Corporate-Tech Planning, Inc., Waltham, Mass.
AUGMENTATION OF RESEARCH AND ANALYSIS CAPABILITIES FOR TIMELY SUPPORT OF AUTOMOTIVE FUEL ECONOMY ACTIVITIES. VOLUME 2: APPENDICES A THROUGH C Final Report
Theodore Taylor, Jr. Dec. 1980 220 p 3 Vol.
(Contract DOT-HS-7-01789)
(PB81-219487; DOT-HS-805904) Avail: NTIS HC A10/MF A01; also available in set of 3 reports HC E15 as PB81-219461 CSCL 13F

The potential fuel economy improvements for passenger cars and light trucks during the 1980 to 1985 time frame, and later to 1990 were assessed. Automotive technology, product planning, manufacturing costs and transportation energy economics were addressed. Tire rolling resistance, aerodynamic drag, and improved lubrications are covered along with manufacturing and consumer costs, unregulated diesel emission research, and alternate means of petroleum conservation. GRA

N82-13020# Corporate-Tech Planning, Inc., Waltham, Mass.
AUGMENTATION OF RESEARCH AND ANALYSIS CAPABILITIES FOR TIMELY SUPPORT OF AUTOMOTIVE FUEL ECONOMY ACTIVITIES. VOLUME 3: APPENDIX D Final Report, Dec. 1977 - Nov. 1979
Theodore Taylor, Jr. Dec. 1980 204 p refs 3 Vol.
(Contract DOT-HS-7-01789)
(PB81-219495; DOT-HS-805905) Avail: NTIS HC A10/MF A01; also available in set of 3 reports HC E15 as PB81-219461 CSCL 13F

Alternative means of petroleum conservation were surveyed and a preliminary estimate of their possible costs and benefits was derived. The potential for petroleum conservation was analyzed for each sector of the economy. These include: electric utilities, residential and commercial buildings, selected industries, and nonautomotive industries. GRA

N82-13191# Ames Lab., Iowa.
POWER-PLANT FLY-ASH UTILIZATION: A CHEMICAL-PROCESSING PERSPECTIVE
G. Bumet and M. J. Murtha 1981 12 p refs Presented at the Portland Cement Assoc. Conf. on Manufacturing Process, Albuquerque, N. Mex., 14-15 Jan. 1981 Prepared jointly with Iowa State Univ. of Science and Technology
(Contract W-7504-eng-82)
(DE81-025452; IS-M-321; CONF-810151-1) Avail: NTIS HC A02/MF A01

Solid wastes from coal combustion, including fly ash, are classified as hazardous under present EPA definitions. Research on fly ash utilization including extraction of metals and uses for process residues is discussed. One process investigated uses a lime-soda sinter method to form soluble aluminate compounds from mixtures of fly ash, limestone, and soda ash. The aluminates are extracted, treated to remove silicates, and precipitated: the precipitate is calcined to metallurgical grade alumina. The extract residue shows promise as a raw material for the production of Portland cement. Process economics, effects of alumina and silica contents of the fly ash, sintering temperatures and time, and sales credits for by-products are discussed. DOE

N82-13192/# AeroChem Research Labs., Inc., Princeton, N. J.
RATE COEFFICIENTS OF COMBUSTION/FUEL CONVERSION REACTIONS BY HIGH-TEMPERATURE PHOTOCHEMISTRY Progress Report, 1 Sep. 1980 - 30 Jun. 1981
William Felder Jul. 1981 7 p refs
(Contract DE-AC02-77ER-04169)
(DE81-027965; DOE/ER-04169/T1; AeroChem-TN-219; COO-4169-6) Avail: NTIS HC A02/MF A01

Reliable kinetic data on isolated elemetary combustion reactions spanning a broad temperature range are required for modeling and scaling studies and reducing the pollutant formation from fossil-fuel burning devices. A new technique, High Temperature Photochemistry (HTP) combines the technology of the High-Temperature Fast-Flow Reactors developed to study kinetics of metal atom/oxide reactions with the flash photolysis technique. Aspect of a partially complete HTP study on chemical reactions CH3 oxidation by O2 and O atoms are presented. DOE

N82-13243*/# Engineering Societies Commission on Energy, Inc., Washington, D. C.
BARRIERS TO THE UTILIZATION OF SYNTHETIC FUELS FOR TRANSPORTATION Final Report
Harry W. Parker and Matthew J. Reilly Oct. 1981 25 p
(NASA Order C-57307-D; Contract DE-AI01-81CS-50006)
(NASA-CR-165517; DOE/NASA-7307/1) Avail: NTIS HC A02/MF A01 CSCL 21D

The principal types of engines for transportation uses are reviewed and the specifications for conventional fuels are compared with specifications for synthetic fuels. Synfuel processes nearing the commercialization phase are reviewed. The barriers to using synfuels can be classified into four groups: technical, such as the uncertainty that a new engine design can satisfy the desired performance criteria; environmental, such as the risk that the engine emissions cannot meet the applicable environmental standards; economic, including the cost of using a synfuel relative to conventional transportation fuels; and market, involving market penetration by offering new engines, establishing new distribution systems and/or changing user expectations.
T.M.

N82-13255/# Comptroller General of the United States, Washington, D.C.
NATURAL GAS PLAN NEEDED TO PROVIDE GREATER PROTECTION FOR HIGH-PRIORITY AND CRITICAL USES Report to the Congress
23 Mar. 1981 57 p
(PB81-228488; EMD-81-27) Avail: NTIS HC A04/MF A01 CSCL 21D

Natural gas legislation and programs implemented over the past decade and currently ongoing at the Federal, state, and local levels are discussed. Some of the shortcomings, inconsistencies, and incompatibilities between legislative intent and program implementation at the various levels are highlighted.
GRA

N82-13256/# Bechtel Power Corp., San Francisco, Calif.
ENVIRONMENTAL AND ECONOMIC COMPARISON OF ADVANCED PROCESSES FOR CONVERSION OF COAL AND BIOMASS INTO CLEAN ENERGY Final Report, Sep. 1977 - Dec. 1978
R. A. Stenzel, B. T. Kown, M. C. Weekes, J. D. Ruby, B. R. Gilbert, C. M. Harper, Y. G. Yim, and R. T. Milligan Aug. 1981 402 p refs
(Contract EPA-68-02-2616)
(PB81-234239; EPA-600/7-81-133) Avail: NTIS HC A16/MF A01 CSCL 21D

Biomass and coal conversion into clean energy is compared on an economic and environmental basis in three regional scenarios: (1) electric power from direct combustion of wood versus conventional coal combustion; (2) synthetic pipeline gas from anaerobic digestion of wheat straw and manure versus high-Btu gasification of coal (HYGAS); and (3) synthetic fuel oil from wood liquefaction versus coal liquefaction (H-Coal). Conceptual commercial-scale plants are described. Capital and operating costs are presented for each of the six plants, and the biomass versus coal economics are compared. General environmental impacts of biomass and coal resource collection are assessed and compared in the scenario contexts. GRA

N82-13263/# California Univ., Livermore. Lawrence Livermore Lab.
ULTIMATE IN BUILDING ENERGY ANALYSIS: DOE-2 AND BLAST
B. D. Hunn 1981 33 p refs Presented at the Symp. Energy and Big Building Design, Philadelphia, 25-26 May 1981 Submitted for publication
(Contract W-7405-eng-36)
(DE81-028703; LA-UR-81-2288; CONF-8105107-1) Avail: NTIS HC A03/MF A01

The DOE-2 and BLAST computer programs are investigated in terms of their usefulness in building energy analysis. DOE-2 and BLAST are generally classed as high-level, computer-dynamic methods that are based on hour-by-hour computation. The characteristics of DOE-2 and BLAST are discussed with emphasis on their solar simulation features, and their capabilities are contrasted and related. Typical applications of the programs to the retrofit of existing buildings and the design of new buildings, are presented. The passive solar retrofit of an office building, the use of DOE-2 as a predesign analysis tool, and the use of BLAST in a research and development application are all described. Future directions in research and development needs for high level building energy analysis tools and the progress being made toward increased use of these tools are discussed. DOE

N82-13267/# Connecticut Dept. of Transportation, Wethersfield.
CONSTRUCTION OF A RECYCLED PORTLAND CEMENT CONCRETE PAVEMENT Construction Report, Oct. 1979 - May 1980
Keith R. Lane Sep. 1980 43 p refs
(HPR Proj. 646)
(PB81-233553; FHWA/CT-80/12; Rept-646-1-80-12) Avail: NTIS HC A03/MF A01 CSCL 13B

Connecticut's first experience with Portland cement concrete recycling is described. The test location was on I-84 in Waterbury, a major expressway which required extensive realignment and widening. The primary concern was to obtain the technical expertise to design and place a recycled pavement. Secondary factors also investigated were the analysis of environmental, economic and energy factors relative to the option of recycling or new construction of a portland cement concrete pavement.
GRA

N82-13392/# Foster-Miller Associates, Inc., Waltham, Mass.
DESIGN AND DEVELOPMENT OF A RECIPROCATING LOW-TEMPERATURE FREON EXPANDER
S. J. Hynek, A. C. Harvey, R. L. Demler, D. H. Walker, and H. H. Fuller 1981 17 p Presented at the Inter-Soc. Energy Conversion Eng. Conf., Atlanta, 9-14 Aug. 1981
(Contract W-7405-eng-26)
(DE81-028609; CONF-810812-34) Avail: NTIS HC A02/MF A01

The design and development of a 20-ton refrigeration system to be powered by 140 F waste hot water is described. The system consists of a Rankine cycle driving a reverse-Rankine cycle, integrated in that they share a common working fluid, a common condenser, and a common crankcase housing the expander and compressor. A reciprocating single-acting counterflow expander provides a combination of high efficiency in the desired capacity range, modularity, and adaptability to existing compressors. Because the temperatures and pressures of the Rankine cycle fall within the design envelope of a standard refrigeration compressor, the compressor and expander could be housed within the same crankcase by converting some of the compressor cylinders to expander cylinders by replacing the cylinder heads.
DOE

N82-13435/# Department of Energy, Bartlesville, Okla.
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES, THIRD SERIES: 1977 CHRYSLER 318 CID (5.2L), 2V Interim Report
D. E. Koehler, W. F. Marshall, and K. R. Stamper Jun. 1981 60 p
(PB81-233025; DOT-TSC-NHTSA-81-6; BETC/OP-79/2; DOT-HS-805814; Rept-13) Avail: NTIS HC A04/MF A01 CSCL 21G

Dynamometer tests of a 1977 Chrysler 318 CID engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady state engine operating modes were performed. Engine performance data for estimating emissions and fuel economy for varied engine service and duty were obtained. Basic engine characteristic data required as

input for engineering calculations involving ground transportation are provided. GRA

N82-13489# Bureau of Mines, Pittsburgh, Pa. Research Center.
SUPPRESSION OF COAL DUST EXPLOSION BY WATER BARRIER IN A CONVEYOR BELT ENTRY
I. Liebman and J. K. Richmond Jun. 1981 34 p refs
(PB81-233306; BM-RI-8538) Avail: NTIS HC A03/MF A01 CSCL 08I

Experiments on coal dust explosion suppression were conducted in a simulated working mine environment. It was shown that a coal dust explosion can be readily initiated in a conveyor belt entry and the explosion can spread into adjacent entries through opened crosscuts to propagate for long distances even though the adjacent entries are rock ducted. Passive water barriers are effective in suppressing explosions on a beltway; however, barrier efficiency is reduced by opened crosscuts. It is indicated that the beltway barrier should have continuous rows of water filled tubs covering long distances along the entry.GRA

N82-13493*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A PRELIMINARY ESTIMATE OF FUTURE COMMUNICATIONS TRAFFIC FOR THE ELECTRIC POWER SYSTEM
Roger M. Barnett 15 Oct. 1981 73 p refs
(Contracts NAS7-100; DE-AI01-79ET-29372)
(NASA-CR-165015; JPL-Pub-81-41; DOE/ET-29372/2) Avail: NTIS HC A04/MF A01 CSCL 10B

Diverse new generator technologies using renewable energy, and to improve operational efficiency throughout the existing electric power systems are presented. A description of a model utility and the information transfer requirements imposed by incorporation of dispersed storage and generation technologies and implementation of more extensive energy management are estimated. An example of possible traffic for an assumed system, and an approach that can be applied to other systems, control configurations, or dispersed storage and generation penetrations is provided. E.A.K.

N82-13512# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
ALTERNATE HYBRID POWER SOURCES FOR REMOTE SITE APPLICATIONS Final Report, Feb. 1980 - Feb. 1981
W. Richard Powell, Robert J. Taylor, J. L. Baron, E. E. Mengel, and J. C. Ray Feb. 1981 229 p refs
(Contracts N00024-78-C-5384; MIPR-Z-70099)
(AD-A099471; USCG-D-06-81) Avail: NTIS HC A11/MF A01 CSCL 10/2

Operation of diesel electric generators at remote Coast Guard sites are discussed. The electric power required by modules and subsystems in a modern lighthouse was investigated. The availability of wind power, solar energy, and other renewable energy sources in the local environment at remote lighthouses and other sites is discussed. A life cycle cost analysis methodology applicable to continuously variable life expectancies is developed and illustrated. Diesel generator costs, including service visit expenses, are modeled. Other factors relating to the analysis of alternate energy systems as supplements to diesel electric generators at remote sites are discussed. Author

N82-13522# Department of Energy, Oak Ridge, Tenn. Technical Information Center.
INFORMATION RESOURCES IN THE USA ON NEW AND RENEWABLE ENERGY, A DESCRIPTION AND DIRECTORY
1 Jun. 1981 81 p Presented at the United Nations Conf., Nairobi, Kenya, Aug. 1981
(DE81-028867; CONF-810802-2) Avail: NTIS HC A05/MF A01

The production dissemination, and availability of US scientific and technical information about new and renewable energy resources, the policy framework within which the technologies are developed, and the roles of public and private sectors are reported. A directory of sources of additional information, printed material, computerized data bases, institutional services, personal contacts, about the use of new and renewable energy is included. DOE

N82-13523# Oak Ridge National Lab., Tenn. Energy Div.
ANNUAL CYCLE ENERGY SYSTEM EXPERIMENTAL PERFORMANCE AND NATIONAL APPLICABILITY
Van D. Baxter 1981 6 p refs Presented at the IECEC Conf., Atlanta, 9 Aug. 1981 Submitted for publication
(Contract W-7405-eng-26)
(DE81-028570; CONF-810812-32) Avail: NTIS HC A02/MF A01

The energy conserving potential of the annual cycle energy system (ACES) was demonstrated. The performance of the ACES was compared with that of two different air to air heat pumps in an identical house, the control house. The ACES achieved nearly all of its theoretical performance predictions and verified its design criteria. The system delivered residential heating and cooling services while consuming only 57 percent as much electricity as the best conventional alternative tested. Computer studies show the ACES to be applicable to all US climatic zones except those with very low heating needs. DOE

N82-13526# South Carolina Energy Research Inst., Columbia.
RESIDUAL-ENERGY-APPLICATIONS PROGRAM ENVIRONMENTAL ANALYSIS REPORT
Torgny J. Vigerstad and F. J. McCrosson Oct. 1980 48 p refs
(Contract DE-AC09-77ET-12866)
(DE81-027538; DOE/ET-12866/5) Avail: NTIS HC A03/MF A01

Environmental analysis performance support of a facility to test industrial scale waste heat recovery equipment and utilization are documented. Topics covered include: legal requirements, likely sites, and operating characteristics of equipment to be tested. Environmental issues surrounding the use of the P-reactor and Par Pond as sources of heating and cooling water are addressed. The Par Pond cooling system is considered for siting of the Energy Applied Systems Tests (EAST) Facility. The Par Pond system has the potential to confine all potential environmental impacts of the construction and operation of the EAST Facility within the boundaries of the Savannah River Plant. Characteristics of the EAST Facility are described and a general description of Par Pond is given. DOE

N82-13535# Pacific Northwest Lab., Richland, Wash.
TECHNOLOGY ASSESSMENT OF SOLAR ENERGY SYSTEMS: AVAILABILITY AND IMPACTS OF WOODY BIOMASS UTILIZATION IN THE PACIFIC NORTHWEST
W. J. Hopp, A. D. Chockie, and K. J. Allwine Sep. 1981 57 p refs
(Contract DE-AC06-76RL-01830)
(DE82-000705; PNL-3933) Avail: NTIS HC A04/MF A01

The biomass resource base in the Northwest were estimated. Scenarios and a preliminary analysis in the collection and use of forest residues as an energy resource are presented. Four issues that may serve to constrain the total amount of wood residues available for use as fuel are reviewed. DOE

N82-13536# Oak Ridge National Lab., Tenn. Energy Div.
BUILDING A CONSENSUS ABOUT ENERGY TECHNOLOGIES
T. J. Wilbanks Sep. 1981 12 p refs
(Contract W-7405-eng-26)
(DE82-000501; ORNL-5784) Avail: NTIS HC A02/MF A01

The making and sustaining of major energy policy decisions are considered. The major policy alternatives for making energy decision-making more effective are outlined. The focus is on relatively large decisions about energy technologies. The policy alternatives are characterized as being either focused on technology or on social action. Technology focused options include technology choices and improvements. Social action focused options include information, incentives, legitimacy, and institutional changes. But it is clear that they pose several basic philosophical questions, such as whether to base decisions on strong central leadership or on broad consensus formation. And it is clear that the options vary in being best suited for business as usual situations or emergency decision making situations. DOE

N82-13539# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
NEW AND RENEWABLE ENERGY IN THE UNITED STATES OF AMERICA
Jun. 1981 115 p To be presented at the 1981 United Nations

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(DE81-030887; DOE/S-00012) Avail: NTIS HC A06/MF A01

The current technical and economic status of technologies and with and expectations for new and renewable energy sources in the United States are described. The roles of the public and private sectors in developing and using these energy sources are outlined. Specific technologies discussed are: low, intermediate, and high temperature solar collectors; biomass, wind, and ocean energy systems; hydropower; geothermal systems; oil shale; and tar sands. DOE

N82-13547# Horstmann G.m.b.H., Heiligenhaus (West Germany).
A CENTRAL MICROPROCESSOR CONTROLLED ELECTRICAL STORAGE HEATING SYSTEM Final Report
Hendrik Horstmann Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 26 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-182; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 5.50

The use of a microprocessor to control the reloading of electrical storage heaters not only during the night, but whenever the electrical grid is cycled down, was tested. The test setup, used to control a total of about 10 MW installed storage heating in 96 dwellings, is described. It is demonstrated that additional consumers can be connected to the system without demand for more power stations. Author (ESA)

N82-13563# Finnish Meteorological Inst., Helsinki.
SULFUR IN THE AIR IN THE CAPITAL (HELSINKI) METROPOLITAN AREA: ITASAT-PROJECT Final Report [PAEAEKAUPUNKISEUDUN ILMAN RIKKI ITASAT-PROJEKTIN LOPPURAPORTTI]
Markku Wallin, Eija Lumme, Markku Hietamaeki, and Erkki Rantakrans 1981 86 p refs In FINNISH
(RR-614.71) Avail: NTIS HC A05/MF A01

Methods for regionally producing and processing information about air quality, air protection measures, and determining alternative examples for air protection solutions are assessed. The sulfur dioxide content of air is predicted. The effects of various air protection measures and their cost (flue gas desulfurization, use of low sulfur heavy fuel oil) are compared. S.L.

N82-13558# Oak Ridge Associated Universities, Tenn. Inst. for Energy Analysis.
RESPONSE OF THE OCEANS TO INCREASING ATMOSPHERIC CARBON DIOXIDE
C. F. Baes, Jr. Aug. 1981 72 p refs
(Contract DE-AC05-76OR-00033)
(DE81-028178; ORAU/IEA-81-6(M)) Avail: NTIS HC A04/MF A01

The relevant physical and chemical features of the ocean, the observational evidence of its response to increasing atmospheric carbon dioxide, and the uncertainties involved in modeling this response are considered. The deep oceans are near saturation with calcite. The pressure dependence of this solubility and ocean circulation produces calcite supersaturation of the upper ocean. This condition is maintained by photosynthesis and the biogenically controlled precipitation of calcium carbonate. After correcting the effects of biological processes on the composition of seawater, it is evident that the increasing carbon dioxide content of the atmosphere affects the distribution of carbon in the upper ocean. DOE

N82-13559# Mathtech, Inc., Princeton, N. J.
ENVIRONMENTAL IMPACTS OF ENERGY TRANSPORTATION Final Report
J. P. Price Electric Power Research Inst. Sep. 1981 243 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. TPS-76-661)
(DE82-900316; EPRI-EA-2039) Avail: NTIS HC A11/MF A01

The environmental impacts of fuel transportation for the electric utility industry are reviewed. The transportation of coal, oil, natural gas, liquified natural gas methanol and hydrogen are covered. The major impacts coal unit trains are: the creation physical barriers, potential accidents, and noise. It is indicated that more emphasis should be placed on the evaluation of the environmental socio-economic impacts of fuel transportation. DOE

N82-13580# Oak Ridge National Lab., Tenn.
CONTROL OF HYDROCARBONS AND CARBON MONOXIDE VIA CATALYTIC INCINERATION
C. H. Brown, Jr. and J. A. Klein Sep. 1981 113 p refs
(Contract W-7405-eng-26)
(DE82-000508; ORNL/TM-7787) Avail: NTIS HC A06/MF A01

Eight commercially available incineration catalysts are evaluated experimentally to assess their application to control hydrocarbon and carbon monoxide emissions in the tail gases from a Lurgi substitute natural gas plant, which is simulated using bottled gas mixtures. Catalysts are evaluated with respect to the effects of temperature, space velocity, and the presence of hydrogen sulfide and carbonyl sulfide on hydrocarbon and carbon monoxide conversion. The most effective catalysts are a precious metal based catalyst on a monolithic substrate and a nonprecious metal oxide deposited on a solid substrate formed into 3.2 mm diameter spheres. DOE

N82-13585# Los Alamos Scientific Lab., N. Mex.
ENVIRONMENTAL AND RADIOLOGICAL SAFETY STUDIES: INTERACTION OF (238) PuO2 HEAT SOURCES WITH TERRESTRIAL AND AQUATIC ENVIRONMENTS Quarterly Progress Report, 1 Jan. - 31 Mar. 1981
Glenn R. Waterbury (comp.) Sep. 1981 42 p refs
(Contract W-7405-eng-36)
(DE81-032019; LA-8932-PR) Avail: NTIS HC A03/MF A01

The effects on the heat source of terrestrial and aquatic environments to obtain data for design of even safer systems were studied. Data obtained in several ongoing experiments are presented and include data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO2 dissolution rates, soil column experiments to measure sorption of plutonium by soils, and aquatic experiments. DOE

N82-13586# Pacific Northwest Lab., Richland, Wash.
TREATMENT OF BIOMASS GASIFICATION WASTEWATERS USING REVERSE OSMOSIS
S. E. Petty, S. D. Eliason, and M. M. Laegreid Sep. 1981 44 p refs
(Contract DE-AC06-76RL-01830)
(DE82-000698; PNL-4018) Avail: NTIS HC A03/MF A01

Reverse osmosis (RO) as a treatment technology for the removal of organics from biomass gasification wastewaters (BGW) generated from an experimental biomass gasifier was evaluated. Since RO is normally considered a complementary treatment technology, wastewaters were pretreated by biological or wet air oxidation (WAO) processes. This membrane is similar to the NS-100, a membrane which is effective in the separation of organics from solution. Separation of organics from solution was determined by COD removal. Membrane degradation was observed when using full strength and WAO pretreated feeds, but not when using feeds that had undergone biological pretreatment. Color removal was computed for the majority of experiments completed. DOE

N82-13587# Pacific Northwest Lab., Richland, Wash.
TREATMENT OF BIOMASS-GASIFICATION WASTEWATERS BY WET-AIR OXIDATION
C. J. English Sep. 1981 30 p refs
(Contract DE-AC06-76RL-01830)
(DE82-000935; PNL-4013) Avail: NTIS HC A03/MF A01

Production of synthetic natural gas from gasification of biomass results in the generation of a high strength wastewater that is difficult to treat by conventional means. The use of wet air oxidation (WAO) as a treatment method for wastewaters was studied. It is suggested that oxidation of biomass gasification wastewaters (BGW) organics by WAO occurs in a stepwise fashion with large organic molecules first being hydrolyzed and then partially oxidized to low molecular weight intermediates. Complete oxidation of these intermediates is more difficult and most easily accomplished at high reaction temperatures. The best application of WAO to treatment of BGW appears to be as a pretreatment to biological treatment. DOE

N82-13873# National Oceanic and Atmospheric Administration, Boulder, Colo. Office of Weather Research and Modification.
ENVIRONMENTAL EFFECTS OF POLLUTANTS FROM COAL COMBUSTION. 2: THE COLSTRIP, MONTANA POWER PLANT
C. C. VanValin, R. F. Pueschel, and D. L. Wellman Apr. 1981 70 p refs 2 Vol.
(Contract EPA-IAG-D5-E693)
(PB81-234114; NOAA-TM-ERL-OWRM-3; NOAA-81062609) Avail: NTIS HC A04/MF A01 CSCL 13B

Aerosol samples from the plume of a power plant were analyzed for the presence of sulfates and nitrates with the transmission electron microscope using the BaCl2 and Nitron tests. Plume profile were measured for width and thickness. Tracking of the plume of the Colstrip power plant plume with the aircraft provided plume trajectories that were influenced by the underlying terrain by being diverted by as much as 20 from the wind direction at plume altitude, or by being ducted along a valley. It is indicated that there is no difference in ice nucleus concentrations between plume and ambient atmosphere, and the latter shows an increase of an order of magnitude. GRA

N82-13878# Research Triangle Inst., Research Triangle Park, N. C.
ENVIRONMENTAL HAZARD RANKINGS OF POLLUTANTS GENERATED IN COAL GASIFICATION PROCESSES Final Report, Feb. - Apr. 1980
J. G. Cleland Jun. 1981 400 p refs
(Contract EPA-68-02-3170)
(PB81-231698; EPA-600/7-81-101) Avail: NTIS HC A17/MF A01 CSCL 13B

An evaluation and ranking of environmental hazards associated with coal gasification is reported. Applied chemical analytical data were provided by: (1) research with an experimental gasifier; and (2) sampling of four commercial gasification processes. Gas, liquid, tar, and solid streams were analyzed for 300 substances. Hazard potential was measured. Coals tested range from lignite to anthracite. Approximately 50 representative pollutants are emphasized and ranked according to relative environmental hazard potential. GRA

N82-13807# National Oceanic and Atmospheric Administration, Boulder, Colo. Office of Marine Pollution Assessment.
ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF: ANNUAL REPORTS OF PRINCIPAL INVESTIGATORS FOR THE YEAR ENDING MARCH 1980. VOLUME 5: HAZARDS Annual Report
Feb. 1981 665 p refs Sponsored in part by the Bureau of Land Management
(PB81-225732; NOAA-81052107) Avail: NTIS HC A99/MF A01 CSCL 08G

Hazards caused by the environmental conditions are reported. Environmental pollution resulting from the development of oil and gas resources in Alaskan waters was investigated. T.M.

N82-13862# Oak Ridge National Lab., Tenn.
HEALTH AND SAFETY RESEARCH DIVISION Progress Report 1 Oct. 1979 - 31 Mar. 1981
Aug. 1981 100 p refs
(Contract W-7405-eng-26)
(DE81-026088; ORNL-5750) Avail: NTIS HC A06/MF A01

Progress in health and safety research is reported. A summary of the major fields covered includes: basic research in physical sciences, life sciences research and assessment, and multidisciplinary studies on the impact of alternative energy technology and policy options. E.A.K.

N82-13981*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONTROLLED SPEED ACCESSORY DRIVE DEMONSTRATION PROGRAM
Frank W. Hoehn 15 Oct. 1981 105 p refs
(Contracts NAS7-100; DE-AI01-80CS-50194)
(NASA-CR-165010; JPL-Pub-81-83) Avail: NTIS HC A06/MF A01 CSCL 13F

A Controlled Speed Accessory Drive System was examined in an effort to improve the fuel economy of passenger cars. Concept feasibility and the performance of a typical system during actual road driving conditions were demonstrated. The CSAD system is described as a mechanical device which limits engine accessory speeds, thereby reducing parasitic horsepower losses and improving overall vehicle fuel economy. Fuel consumption data were compiled for fleets of GSA vehicles. Various motor pool locations were selected, each representing different climatic conditions. On the basis of a total accumulated fleet usage of nearly three million miles, an overall fuel economy improvement of 6 percent to 7 percent was demonstrated. Coincident chassis dynamometer tests were accomplished on selected vehicles to establish the effect of different accessory drive systems on exhaust emissions, and to evaluate the magnitude of the mileage benefits which could be derived. J.M.S.

N82-13884# Smith (Wilbur) and Associates, New York.
MEASURES OF EFFECTIVENESS OF TRANSPORTATION SYSTEMS MANAGEMENT Final Report
Apr. 1981 43 p refs Prepared jointly with Tri-State Regional Planning Commission
(PB81-233884; UTMA-IT-09-00890-81-1) Avail: NTIS HC A03/MF A01 CSCL 13B

The basic concepts of transportation systems management (TSM) by providing simple classification schemes, geographic conditions of applicability, relative measures of effectiveness, and techniques for quantification were developed. Two key elements are emphasized: coordination of transportation activities, and maximization of efficiency and productivity. Some of the findings reported are: (1) traffic engineering improvements; (2) demand management measures achieve reductions in vehicle miles of travel; and (3) bus lanes and priority entry treatments. GRA

N82-13985# Aerospace Corp., El Segundo, Calif. Environment and Energy Conservation Div.
EVALUATION OF TECHNIQUES FOR REDUCING IN-USE AUTOMOTIVE FUEL CONSUMPTION Final Report, Jun. 1978 - Mar. 1979
L. Forrest, W. B. Lee, and W. M. Smalley Apr. 1981 330 p refs Prepared in cooperation with Transportation Systems Center
(Contract F04701-77-C-0078)
(PB81-233298; DOT-TSC-NHTSA-81-13; DOT-HS-805833) Avail: NTIS HC A15/MF A01 CSCL 13F

Techniques for reducing fuel consumption in the light duty road vehicle fleet are assessed. Modification of vehicles, modification of traffic flow, and modification of driver behavior are considered. Factors included in the evaluation are fuel economy effects, safety impacts, availability for fleet implementation, and unit price. In addition, the implementation of each technique is assessed with regard to number of vehicles impacted, fuel savings effected, national cost, potential problems, and required lead time. Cost effective techniques are ranked in terms of their assessed potential for reducing fleet fuel consumption. GRA

N82-13986# Transportation Systems Center, Cambridge, Mass.
HIGHWAY FUEL ECONOMY STUDY Final Report, Sep. 1979 - Mar. 1981
Robert L. Mason and Russell W. Zub Jun. 1981 155 p refs
(PB81-233850; DOT-TSC-NHTSA-81-18; DOT-HS-805873) Avail: NTIS HC A08/MF A01 CSCL 13F

The fuel consumption changes attributable to speed reduction and compliance with the 55 MPH speed limit are described. The effects of vehicle size and type, and driver-controllable functions on vehicle fuel economy at highway speeds are discussed. Most of the analytical work is related to passenger cars and light trucks, however, medium and heavy trucks, primarily commercial in application, have been included in the highway fuel economy analyses. GRA

N82-14048# California Univ., Livermore. Lawrence Livermore Lab.
LLNL 1981: TECHNICAL HORIZONS
Jul. 1981 49 p
(Contract W-7405-eng-48)
(DE81-028265; UCRL-52000-81-7) Avail: NTIS HC A03/MF A01

Research programs are described in broad terms. A $481 million operating budget is projected for fiscal year 1982, up nearly 13% from last year. In projects for the Department of Energy and the Department of Defense, the Laboratory applies its technical facilities and capabilities to nuclear weapons design and development and other areas of defense research that include

inertial confinement fusion, nonnuclear ordnances, and particle-beam technology. LLNL is also applying its unique experience and capabilities to a variety of projects that will help the nation meet its energy needs in an environmentally acceptable manner. DOE

N82-14071# Arinc Research Corp., Annapolis, Md.
THE USE OF FLIGHT MANAGEMENT COMPUTERS IN AIR CARRIER OPERATIONS IN THE 1980S Interim Report
I. Gershkoff Washington FAA Aug. 1981 113 p refs
(Contract DTFA01-80-C-10030)
(AD-A105621; Rept-1378-11-1-2482; FAA-EM-81-10) Avail: NTIS HC A06/MF A01 CSCL 09/2

The use of on-board flight management computers (FMCs) in air carrier operations has the potential for significant fuel savings. This report assesses the general capabilities of the FMCs currently available. From this information, economic benefits and rates at which aircraft would be equipped were developed. Minimum-cost flight profiles were analyzed for various common conditions to determine the problems associated with incorporating the capabilities of FMCs into a heavy traffic Air Traffic Control environment. GRA

N82-14322# Los Alamos Scientific Lab., N. Mex.
CHEMICAL ELEMENT CONCENTRATIONS IN LIQUIDS AND SOLIDS ASSOCIATED WITH POWER PLANTS USING FGD SYSTEMS
Lawrence Edward Wangen and Marianne Mills Jones Aug. 1981 27 p refs
(Contract W-7405-eng-36)
(DE81-030422; LA-8929-MS) Avail: NTIS HC A03/MF A01

Solid and liquid process steam samples from eight power plants using wet flue gas desulfurizaton (FGD) scrubbers were analyzed for the trace elements As, B, Br, Cl, Cd, Co, Cr, F, Ga, I, Mo, Ni, Pb, S, Sb, Se, Th, U, V, W, and Zn as well as several major and minor elements. Four plants burned high-sulfur coals and three burned low-sulfur coals. One plant used a low-sulfur lignite coal. Four FGD systems used limestone, two used lime, and two used alkaline flyash as scrubbing reagent. Elemental concentration data were used to identify chemical elements of concern regarding their potential for causing environmental harm as a result of the disposal of residues associated with FGD systems. Calcium, Mg, Mn, Ni, Se, and SO4(2-) were identified as most generally problematic. The elements B, Cd, F, and Mo were judged as potentially problematic in certain situations. Generally FGD liquors from power plants that burned low-sulfur western coals had highest concentrations of most trace elements. DOE

N82-14398# Ministry of Housing, Ottawa (Ontario). Project Planning Branch.
RESIDENTIAL SITE DESIGN AND ENERGY CONSERVATION. PART 1: GENERAL REPORT
Jan. 1981 158 p
(DE81-904010; NP-1904010-Pt-1; ISBN-0-7743-6072-0) Avail: NTIS HC A08/MF A01

The energy costs that can be saved by a subdivision design format related to energy conservation that is reasonably acceptable in marketing and aesthetic terms were determined. Six subdivision layouts were designed to densities ranging from 6.5 to 13.6 units per gross acre (1058 to 2232 units) or 16.25 to 34 units per gross hectare. Hourly radiation, temperature, and wind characteristics for a year constitute the local climate data base. Six house types (from detached to apartment units) and seventeen basic house designs (mostly picked at random) were used. The method for calculating the set heat load and an analysis of the results are presented. The study shows that by way of the selection of the more energy efficient traditional house designs, orientation of buildings to maximize solar transmission, and landscaping to reduce the effect of wind, there is a possible residential space heating energy saving of up to 20% for a low density housing development. T.M.

N82-14557# Conoco Norway, Inc., Oslo.
OFFSHORE PETROLEUM INDUSTRY ENVIRONMENTAL DATA REQUIREMENTS: EMPHASIS ON REMOTE SENSING
Ronald L. Gratz *In* ESA Appl. of Remote Sensing Data on the Continental Shelf Jul. 1981 p 31-43 refs
Avail: NTIS HC A13/MF A01; ESA, Paris FF 125

Data quality and coverage requirements for the remote sensing of oceanographic and meteorological factors affecting the development of offshore hydrocarbon resources are considered, using a combination of fine-grid hindcasting and surface truth measurements. The establishment of data banks able to accumulate 20-30 years of climatological data for use in future designs is recommended. Special measurement programs are planned for data collection during storms. Remote sensing was used to measure several factors important to the petroleum industry, i.e., waves, winds, currents, and sea ice. Application to weather forecasting is shown. The use of surface truth data in the calibration and verification of measurements for remote sensing is suggested. Possible communications channels for the exchange of remote sensing data are assessed. Author (ESA)

N82-14626# Open Univ., Milton (England). Energy Research Group.
THE NUCLEAR CONTROVERSY: UNEQUAL COMPETITION IN PUBLIC POLICY-MAKING
Ian Sanderson May 1980 76 p refs
(ERG-035) Avail: NTIS HC A05/MF A01

The public policy making process as regards nuclear power is analized and the epistemological basis for such an analysis is examined. It is asserted that disputes over the development of nuclear power are not primarily about the objective facts of the matter but rather derive from differences in basic assumptions about, and evaluatory perceptions of, society, technology and the nature of progress. The balance of power in such disputes is therefore not mainly determined by the 'correctness' of the facts upon which a position rests but rather by the extent to which underlying assumptions and values accord with prevailing ideological themes. A meaningful debate can be guaranteed only through the establishment of institutional structures which provide a framework of truely democratic participation and equality of power and influence. M.G.

N82-14632*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN OF AN ENERGY CONSERVATION BUILDING
Ronald N. Jensen Nov. 1981 32 p refs
(NASA-TM-83175) Avail: NTIS HC A03/MF A01 CSCL 10A

The concepts in designing and predicting energy consumption in a low energy use building are summarized. The building will use less than 30,000 Btu/sq.ft./yr. of boarder energy. The building's primary energy conservation features include heavy concrete walls with external insulation, a highly insulated ceiling, and large amounts of glass for natural lighting. A solar collector air system is integrated into the south wall. Calculations for energy conservation features were performed using NASA's NECAP Energy Program. T.M.

N82-14644# American Bar Association, Washington, D.C. Special Committee on Energy Law.
NEED FOR POWER AND THE CHOICE OF TECHNOLOGIES: STATE DECISIONS ON ELECTRIC POWER FACILITIES
Jun. 1981 221 p refs
(Contract DE-AC01-79RG-10004)
(DE81-025960; DOE/EP-10004/1) Avail: NTIS HC A10/MF A01

The decision-making processes at the state level regarding the licensing of electric generating facilities were assessed. The basic issues addressed are the need for power and choice of technology: state decisions which directly influence and affect the nation's energy supply, and the tradeoffs involved in meeting energy demand. The areas of special emphasis included the legal mechanisms and regulatory procedures used to determine and resolve these issues. The effectiveness of state decision-making was assessed, focusing on legal and administrative histories and accommodation of interests of concerned parties. Recent innovations to enhance the decision-making process were also assessed where applicable. No particular substantive results are advocated in the findings. The recommendations presented are broad in scope. DOE

N82-14645# Natural Resources Defense Council, Inc., San Francisco, Calif.
PROJECTING REGIONAL POTENTIALS FOR COST-EFFECTIVE ENERGY CONSERVATION AND RENEWABLE RESOURCE APPLICATIONS: A FEASIBILITY STUDY

1980 52 p refs
(Contract DE-FG03-79CS-10045)
(DOE/CS-10045/T3) Avail: NTIS HC A04/MF A01

The feasibility is discussed of preparing an instruction manual that would enable a modeler in a particular region to set up a calculation method or predicting energy use. Such a manual would concern itself primarily with the three energy-consuming sectors most relevant to utilities' demand projections. Data requirements for each of the three sectors (residential, commercial, and industrial) are described and some initial guidance is provided as to how these needs can be filled. The methods for separate calculations of energy consumed by each end use in each sector are described. Each end use is discussed separately for the residential sector, but only in aggregate for the commercial and industrial sectors. DOE

N82-14848# Purdue Univ., Lafayette, Ind. Energy Policy Research and Information Program.
PROGRESS REPORT TO THE DEPARTMENT OF ENERGY IN SUPPORT OF BASIC ENERGY AND POLICY RESEARCH
15 Jul. 1981 326 p refs
(Contract DE-AS02-79ER-10044)
(DE81-025882; DOE/ER-10044/T1) Avail: NTIS HC A15/MF A01

Research areas include: light path of carbon reduction in photosynthesis: heat transfer in coal-ash slags; mechanism of plant cell enlargement in Gymnosperms; emulsion stability in enhanced oil recovery; selective transfer phenomenon in friction and wear; conceptual design of the Purdue Compact Torus/Passive Liner Fusion Reactor; integration of farm level alcohol production consistent with the economic and labor constraints of a farming operation, and newsmedia coverage of selected energy policy proposals. DOE

N82-14850# Argonne National Lab., Ill. Integrated Assessments and Policy Evaluation Group.
ANALYSIS OF POTENTIAL COGENERATION IMPACTS ON ELECTRICITY GENERATION BY THE CENTRAL MAINE POWER COMPANY
Jerry L. Gillette and Kenneth A. Hub Apr. 1981 36 p refs
(Contract W-31-109-eng-38)
(DE81-029991; ANL/CNSV-TM-76) Avail: NTIS HC A03/MF A01

Two types of cogeneration design - one utilizing a backpressure turbine, the other an extraction turbine - were studied. It was assumed that these facilities were constructed to produce electricity that could be sold to the electric utility. The analysis included a single-year study of two different capacity-purchase options under consideration by the electric utility. An extended period was also analyzed so that the effects of demand growth and additions and subtractions of capacity on the cogeneration potential could be examined. It is found that some savings of oil could be realized with coal-based cogeneration, and that the quantity of such savings are somewhat dependent on the purchase option, the demand growth rate, and the cogenerator design. It is concluded that both cogenerator designs have some economic viability, but that the backpressure turbine type has a decided advantage due to its significantly lower heat rate. T.M.

N82-14851# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
ANALYSIS OF THE ENERGY IMPACTS OF THE DOE APPROPRIATE ENERGY TECHNOLOGY SMALL GRANTS PROGRAM: METHOD AND RESULTS
Bart Lucarelli, Jeff Kessel, Josh Kay, Janet Linse, Susan Tompson, and Mark Homer Aug. 1981 43 p refs
(Contract W-7405-eng-48)
(DE81-029844; LBL-12253-Rev) Avail: NTIS HC A03/MF A01

Methods for assessing the energy savings of projects in the appropriate technology program (AT) and how to apply these methods to obtain estimates of energy impacts was studied. Program energy savings were estimated from project savings by statistical inference. Direct energy savings and methods and results of the economic analysis are discussed. Indirect energy savings and program energy savings and the methods used to obtain them are estimated. Improvement of project selection which increase program energy savings and two approaches for conducting future energy impact studies are presented. DOE

N82-14853# Department of Energy, Washington, D. C. Office of Market Analysis.
INTERNATIONAL ENERGY INDICATORS
R. M. Weiss, ed. Jul. 1981 30 p
(DE81-028117; DOE/IA-0010/13) Avail: NTIS HC A03/MF A01

Data are presented in graphs and tables on the following: world crude oil production by area, annually, 1974 through 1980, and monthly, October 1980 through April 1981; OPEC crude oil productive capacity, installed, maximum sustainable, and available, by country; world crude oil and refined product inventory levels, 1975 through 1981; oil consumption in OCED countries, 1975 through 1981; USSR crude oil production and exports, 1975 through April 1981; free world (by country) and US nuclear electricity generation, 1973 through 1980 and January to May 1981 and current capacity by country; US domestic oil supply (monthly) 1977 through 1980; US gross imports of crude oil and products, 1973 and 1974 annually, and 1975 through 1980 and monthly from January to June 1981; cost of Saudi crude oil in current and 1974 dollars from December 1974 through March 1981; US coal trade from January 1975 to March 1981; US natural gas trade from January 1975 through April 1981; summary of US merchandise trade, quarterly, from Quarter I, 1977 through Quarter I, 1981; and US energy/GNP ratio, annually, 1974 through 1980, and quarterly from 1974 through March 1981. DOE

N82-14859# Energy, Inc., Idaho Falls, Idaho.
ENERGY RECOVERY FROM MUNICIPAL WASTE DEVELOPMENT PROGRAM FOR IDAHO FALLS, IDAHO Final Report
Jul. 1981 155 p refs
(Contract DE-AC01-79CS-20240)
(DE81-029999; DOE/CS-20240/1) Avail: NTIS HC A08/MF A01

The development of a demonstration facility to show that fluidized-bed technology is a viable means to recover resources from municipal wastes in Idaho Falls is described. The tasks described include: (1) evaluation of the energy market of Idaho Falls to identify potential customers for recovered energy and to determine what form of energy would be economically viable; (2) evaluation of the municipal solid waste of Idaho Falls, determining its approximate composition, heating value, production rates, and seasonal variations; (3) development of a resource recovery facility concept that will be economically attractive to the city and technically feasible; and (4) evaluation of such topics as zoning, legal limitations, and environmental aspects of the facility to determine its compatibility with the city of Idaho Falls. DOE

N82-14862# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
POTENTIAL ENERGY SAVINGS IN THE RESIDENTIAL SECTOR OF THE UNITED STATES
John Ingersoll Jun. 1981 11 p refs Presented at the Intern. Conf. on Energy Use Management, West Berlin, 26-30 Oct. 1981
(Contract W-7405-eng-48)
(DE81-028873; LBL-12862; CONF-811006-3) Avail: NTIS HC A02/MF A01

The state-of-the-art computer program, DOE 2.1, was used to simulate the hour-by-hour thermal performance of residential buildings in the four major climate zones of the United States, and a life-cycle cost analysis was applied to determine the optimal energy requirement of a typical house demonstrate that present levels of energy consumption can be reduced by a factor of two without compromising health and comfort standards. Within present technology, additional energy savings can be achieved but not yet in a cost-effective way. DOE

N82-14864# Oak Ridge Associated Universities, Tenn.
EDUCATION AND TRAINING IMPLICATIONS OF BIOMASS ENERGY SYSTEM USE
S. E. Bell, R. M. Gove, and J. R. Little Aug. 1981 44 p refs
(Contract DE-AC05-76OR-00033)
(DE81-029956; ORAU-182) Avail: NTIS HC A03/MF A01

Direct observations of 189 biomass-related operations combined with existing reports, feasibility studies, and expert opinion are used to assess the education and training implications of biomass energy system use. The number of permanent jobs

in activities related to biomass energy production could easily reach the hundreds of thousands by the end of the century. However, national employment related to biomass energy will represent only a very small portion of the employment in any major occupational category. In addition, an analysis of occupational skill requirements suggests that the impacts on education and training institutions are likely to be minimal. Regional shortages could develop for foresters, forestry technicians, chemists, laboratory technicians, process operators, and certain engineers; but these are likely to be in response to economy-wide growth rather than biomass energy-related activity alone. DOE

N82-14803# Battelle Pacific Northwest Labs., Richland, Wash.
CARCINOGENIC EFFECTS OF COAL-CONVERSION MATERIALS
R. A. Renne and L. G. Smith Apr. 1981 29 p refs Presented at the Ind. Hyg. and Occupational Med. in Coal Conversion Proj. Workshop, Washington, D.C., 7 Nov. 1980 Submitted for publication
(Contract DE-AC06-76RL-01830)
(DE81-028108; PNL-SA-9516; CONF-801143-2) Avail: NTIS HC A03/MF A01

The correlation between mutagenesis and carcinogenesis data on complex mixtures (synfuel materials) was determined. The heavy distillate is highly mutagenic compared with the other materials tested and it was also highly carcinogenic in a mouse skin painting assay. The fractions, we give different results from those of the mutagenesis assays. The basic tar and the neutral tar skin carcinogenesis data correlate fairly well with the mutagenesis data. The need for caution against depending heavily on equating PNA content with carcinogenic activity is emphasized. It is recommended that primary aromatic amines are also monitored. DOE

N82-14875# University of Southern California, Los Angeles. Social Science Research Inst.
VALUE TREE ANALYSIS OF ENERGY SUPPLY ALTERNATIVES
William G. Stillwell, Detlof vonWinterfeldt, and Richard S. John Jun. 1981 41 p refs
(Contract MDA903-80-C-0194)
(AD-A105629; SSRI-81-2) Avail: NTIS HC A03/MF A01 CSCL 05/10

The use of value trees in multiattribute evaluations of energy supply alternatives was examined. A value tree relating general values and concerns to specific value relevant attributes was constructed to compare three energy options: nuclear, coal, and a combined geothermal and conservation package. Both hierarchical and non-hierarchical weighting procedures were used to rate the energy options. Several additive multiattribute models were constructed and compared with holistic rankings and ratings of the three options. Three basic findings were: (1) hierarchical weights were steeper than non-hierarchical weights; (2) groups identified by their holistic first choice showed substantial agreement in their assessment of attribute weights; (3) convergence of MAU model parameters resulted in a 'common model', consistent with holistic evaluations of the pro-conservation group, and generally inconsistent with those of the pro-nuclear group. This differential consistency between model composites and holistic evaluations is interpreted as a result of weight parameter distortions due to social desirability and a neglect to consider attribute value ranges when making weight judgments. Author

N82-14903# Teknekron, Inc., McLean, Va.
ENVIRONMENTAL READINESS DOCUMENT. ADVANCED ISOTOPE SEPARATION PROGRAM
Aug. 1981 56 p refs
(Contract DE-AC01-79EV-10292)
(DE81-029952; DOE/EP-0029) Avail: NTIS HC A04/MF A01

The uncertainties to be resolved through research development and those that constitute a limit on the confidence that can be placed in the conclusions are addressed. The conclusions are presented, giving the probabilities of an adverse finding resulting from further environmental research. The impacts and concerns are treated without reference to specific sites or location. The technology from which the environmental concerns emerge is described. Drawn from the technology program office and the Environmental Development plan for the Advanced Isotope Separation Program (AIS) is provided. The likelihood of adverse findings concerning the environmental acceptability of the technology, the problems and uncertainties stemming from current or anticipated environmental regulation, and the environmental and control considerations is examined. On this basis, an assessment is offered of the existing or potential barriers to commercialization. Environmental control research is discussed and associated costs are addressed. The impact of environmental-related costs on the cost of enriching uranium by the AIS techniques is also addressed. Current and possible new standards related to this technology are identified. Estimates of relative chemical hazards are provided. The feed and product associated with the current nuclear fuel cycle facilities and the changes that may be required by introduction of AIS into the enrichment enterprise are characterized. A glossary is included. DOE

N82-14910# Battelle Pacific Northwest Labs., Richland, Wash.
COMPARISON OF POTENTIAL RADIOLOGICAL CONSEQUENCES FROM A SPENT-FUEL REPOSITORY VERSUS NATURAL-URANIUM DEPOSITS
M. O. Cloninger and O. J. Wick Dec. 1980 15 p refs Presented at the ANS Waste Management Conf., Tucson, Ariz., 23-26 Feb. 1981
(Contract DE-AC06-76RL-01830)
(DE81-028232; PNL-SA-8881; CONF-810217-19) Avail: NTIS HC A02/MF A01

The long term hazard from spent fuel in a geologic repository is found to be comparable to that of a large ore deposit, although the specific nuclide concentration in an individual fuel element is not duplicated in nature. A repository constructed within reasonable constraints present no greater hazard than a large ore deposit. The natural hazard due to some observed radioactive releases to the biosphere in the United States far exceeds any that could reasonably be expected from a spent-fuel repository. Use natural ore deposits as a basis for criteria for nuclear waste repositories is so variable that it does not allow a specific criterion to be stated in absolute terms. If the naturally radioactive environment is to be used as a criterion for repositories, the radiological quality of the environment in the immediate region of a specific repository, and an acceptable potential increase in that radiological content due to the existence of the repository should be considered. M.D.K.

N82-14959# Comptroller General of the United States, Washington, D.C.
MILLIONS WASTED TRYING TO DEVELOP MAJOR ENERGY INFORMATION SYSTEM Report to the Congress
15 May 1981 81 p refs
(AFMD-81-40) Avail: NTIS HC A05/MF A01

A Federal energy information system created to improve Federal and State energy regulation by providing computerized access to current energy data is reviewed. It is concluded that the system failed because management deficiencies existed in planning, development, and implementation. Moreover, the cost and progress of the system was not monitored. Poor communication among system developers and intended users at the Federal and State levels, lack of continuous involvement and support from top Federal management, and disruptions in both organization and personnel are also cited as reasons for the system's failure. R.J.F.

N82-14987# California Univ., Livermore. Lawrence Livermore Lab.
FUTURE OF ELECTRICITY FOR AUTOMOBILES: ADVANCED ELECTRIC VEHICLE CONCEPTS
Lawrence G. OConnell 29 Jul. 1981 14 p refs Presented at 8th Elec. Vehicle Council Symp., Baltimore, 21 Oct. 1981
(Contract W-7405-eng-48)
(DE81-028235; UCRL-85526; CONF-811010-3) Avail: NTIS HC A02/MF A01

An electric vehicle, hybrid vehicle, and other nonpetroleum electricity based systems, such as a fuel cell vehicle are evaluated. Performance criteria for such vehicles are presented and, in addition, various concepts that may be suitable for these vehicles are identified-their capabilities are discussed as well as the difficulties that must be overcome prior to commercialization in each case. DOE

N82-15142# Walther Cie A.G., Cologne (West Germany).
PROCESS FOR REMOVING SULFUR OXIDES FROM GASES WITH DIRECT PRODUCTION OF A USABLE FINISHED

REACTION PRODUCT Final Report, Oct. 1980
Heinz Juergen Fischer and Georg Kremer Bonn Bundesministerium fuer Forschung und Technologie Jul. 1981 38 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-102; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8

During the described phase of testing, the waste-water-free Walther-process could be advanced considerably and tried in the final process conception after a coal-fired power-station block. The ammonia sulfate obtained as a waste-product, meets the requirements of the fertilizer industry. Further processing of this pulverous waste-product to obtain a marketable end-product was investigated and demonstrated in a pelletizing unit with subsequent drying in a drum-type drier. The possibility of reheating the gases in a FGD-plant (flue-gas desulfurization plant) without application of energy from foreign source was proven by the use of a regenerative heat exchanger. As regards spray-drying, a variant was investigated: a partial flow of the high-temperature flue-gas was branched before the airheater and spray-drying of the oxidized scrubbing liquid resulting from the desulfurization process was carried out in this partial flow. Author

N82-15188# KHD Humboldt Wedag A.G., Cologne (West Germany). Hauptabteilung Forschung und Entwicklung.
BAKING OF CARBON ANODES FOR THE ELECTROLYSIS OF ALUMINUM BY ELECTRIC RESISTANCE HEATING Final Report, Apr. 1980
Ernst Schultze-Rhonhof Bonn Bundesministerium fuer Forschung und Technologie Sep. 1981 41 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-168; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8,60

A distinct reduction of the energy input compared with the usual methods is possible when electric energy is substituted for fossil energy. Carbon anodes in a 1:1 scale can be baked uniformly by direct electric resistance heating. The characteristic chemical and physical data meets all requirements of the aluminum industry. The energy input has not yet come up to expectations. A.R.H.

N82-15210# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
US CERAMIC HEAT EXCHANGER TECHNOLOGY: STATUS AND OPPORTUNITIES
V. J. Tennery 1981 5 p Presented at the Conf. on Advancement in Heat Exchangers, Dubrovnik, Yugoslavia, 7 Sep. 1981
(Contract W-7405-eng-26)
(DE81-029686; CONF-810946-1) Avail: NTIS HC A02/MF A01

The status of ceramic heat exchanger technology in the United States is reviewed including the basis for interest in designing, building, and demonstrating these components for application in energy systems. Ceramic heat exchangers for waste heat recovery and for advanced energy systems are discussed. DOE

N82-15219# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.
SURVEY OF PROPOSED METHODS OF BURNING ALCOHOL IN DIESEL ENGINES
D. E. Foster 1980 10 p refs Presented at the Canadian Natl. Power Alcohol Conf., Winnipeg, Manitoba, 20 Jun. 1980
(Contract DE-AC02-79CS-50025)
(DE81-025834; CONF-8006185-1) Avail: NTIS HC A02/MF A01

Different methods of burning alcohol in diesel engines are discussed. The primary difficulty in using alcohol as a diesel fuel is initiation of the flame. The methods are categorized by the ignition technique used: spark or hot surface; pilot injection which includes twin injection and fumigation, cetane improvement and diesel/alcohol mixtures. Each method is analyzed on the basis of the maximum amount of alcohol that can be substituted for diesel fuel and the likelihood for retrofitting on current engines. It is concluded that emulsification and fumigation are currently the two most feasible methods for adapting diesel engines to burn alcohol. DOE

N82-15242# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
THEORETICAL BASIS OF THE DOE-2 BUILDING ENERGY USE ANALYSIS PROGRAM
Richard B. Curtis Apr. 1981 15 p refs Presented at the Intern. Energy Agency Conf., West Berlin, 6-10 Apr. 1981
(Contract W-7405-eng-48)
(DE81-028896; LBL-12300) Avail: NTIS HC A02/MF A01

A user-oriented, public domain, computer program was developed that will enable architects and engineers to perform design and retrofit studies of the energy-use of buildings under realistic weather conditions. The DOE-2.1A has been named by the US DOE as the standard evaluation technique for the Congressionally mandated building energy performance standards (BEPS). A number of program design decisions were made that determine the breadth of applicability of DOE-2.1. Such design decisions are intrinsic to all building energy use analysis computer programs and determine the types of buildings or the kind of HVAC systems that can be modeled. In particular, the weighting factor method used in DOE-2 has both advantages and disadvantages relative to other computer programs. DOE

N82-15367# Technische Universitaet, Hanover (West Germany). Abt. Kaeltetechnik.
ROTATING REGENERATIVE HEAT EXCHANGER FOR ENERGY RECOVERY IN CHEMICAL PLANTS Final Report, Jul. 1979
Reinhard Vauth Bonn Bundesministerium fuer Forschung und Technologie Jul. 1981 198 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-099; ISSN-0340-7608) Avail: NTIS HC A09/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 36,30

The behavior of a rotary heat exchanger was analyzed with special regard to heat and mass transfer. Parallel to measurements at such a rotary heat exchanger with non-absorbant matrix a mathematic model was developed to simulate the heat and mass transfer. The correlation of experimental and theoretical results shows that the experimental data can be calculated by the mathematical model within an accuracy which is usual for calculating heat and mass transfer. Within a variation of several parameters for the working medium (humid air) the influences of operating conditions on the exchange characteristic of regenerative heat exchangers with rotating matrix were examined. A study of parameters with the working medium flue-gas, which was thought as a possible application of the mathematic model, confirms the results which were found with the working medium humid air. Author

N82-15463# Department of Energy, Bartlesville, Okla. Energy Technology Center.
AUTOMOTIVE FUEL ECONOMY: POTENTIAL IMPROVEMENT THROUGH SELECTED ENGINE AND DIFFERENTIAL GEAR LUBRICANTS Final Report
Ted M. Naman Jul. 1981 50 p refs
(Contract DO-SC-RA-78-19)
(PB81-240467; DOT-TSC-NHTSA-81-8; DOT-HS-805895)
Avail: NTIS HC A03/MF A01 CSCL 21G

The effects of four engine lubricants and three differential gear lubricants on the fuel economy of two 1978 automobiles operated at 20F, 70F, and 100F ambient temperatures are evaluated. The engine lubricants were evaluated using the 1978 Federal Test procedure and steady state tests from a cold start. The gear lubricants were evaluated in steady state operation from a cold start. GRA

N82-15488*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
INVESTIGATION OF THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO ENVIRONMENTAL MONITORING
M. L. Rader, Principal Investigator Aug. 1980 76 p ERTS
(Contract NAS9-15800)
(E82-10010; NASA-CR-161071; JSC-16759; LEMSCO-15175)
Avail: NTIS HC A05/MF A01 CSCL 13B

Activities and results are reported of a project to investigate the application of remote sensing technology developed for the LACIE, AgRISTARS, Forestry and other NASA remote sensing projects for the environmental monitoring of strip mining, industrial

pollution, and acid rain. Following a remote sensing workshop for EPA personnel, the EOD clustering algorithm CLASSY was selected for evaluation by EPA as a possible candidate technology. LANDSAT data acquired for a North Dakota test sight was clustered in order to compare CLASSY with other algorithms.
A.R.H.

N82-15514# Teknekron, Inc., McLean, Va.
COAL RESOURCES AND SULPHUR EMISSION REGULATIONS: A SUMMARY OF 8 EASTERN AND MIDWESTERN STATES Final Report, Apr. 1979 - Mar. 1981
Richard A. Chapman and Marcella A. Wells May 1981 112 p refs Prepared for Versar, Inc., Springfield, Va.
(Contract EPA-68-02-3136)
(PB81-240319; EPA-600/7-81-086) Avail: NTIS HC A06/MF A01 CSCL 13B

Coal resources, current coal use, and the effectiveness of SO2 control strategies for use by coal users, regulators, and administrators in future coal related decisions were analyzed. The eight major eastern and midwestern coal producing states are discussed and each state's analysis includes a general overview of the coal industry, an overview of coal properties, a description of major coal seams, an analysis of the quantity of coal available to meet various SO2 emission regulations, and information regarding the sulfur content of coals used by utilities in 1979. Physical coal cleaning and the use of low sulfur coal as viable emission control strategies are emphasized. The coal assessment processor model was developed to determine the quantity of coal that would be available in each state to meet various SO2 emission regulations using one or a combination of alternative SO2 control technologies. GRA

N82-15543# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
ROLE OF LARGE SCALE ENERGY SYSTEMS MODELS IN R&D PLANNING
J. Lamontagne Nov. 1980 13 p refs Presented at the ORSA/TIMS Conf., Colorado Springs, 9 Nov. 1980
(Contract DE-AC02-76CH-00016)
(DE81-026058; BNL-29751; CONF-801126-3) Avail: NTIS HC A02/MF A01

The development of alternative technologies to provide new sources of energy and extend the lives of current ones is discussed. The influence of model results on energy policy makers who are not knowledgable about flaws or uncertainties in the models, errors in assumptions in model inputs which can result in faulty forecasts, the overall usefulness of energy system models, and model limitations are discussed. It is concluded that energy models should be clearly related to specific issues and methodologies should be clearly related to specific decisions, and allow adjustments to be easily made for alternative assumptions and for additional knowledge gained during the evolution of the energy system. DOE

N82-15553# Stoller (S. M.) Associates, New York.
POTENTIAL CONTRIBUTION OF CURRENTLY OPERATING NUCLEAR-FUELED ELECTRIC-GENERATING UNITS TO REDUCING US OIL CONSUMPTION
R. H. Koppe, Eric A. J. Olson, and Kenneth R. VanHowe 30 Sep. 1980 56 p Prepared for ORNL
(Contract W-7405-eng-26)
(DE81-030497; ORNL/Sub-80/40416/1) Avail: NTIS HC A04/MF A01

The prospect for performance improvement in the 62 operating light water reactors was examined. It is found that in the short term, capacity factor improvement of about 16 percent can be achieved, in response to a short term energy crisis. In the long term a gain of 18 percent can be achieved. Such gains represent a decrease in equivalent oil consumption of approximately 350,000 barrels a day. Potential increases in the operating power level of these units, are evaluated. This total short term power level increase would be equivalent to 138,000 barrels of oil per day. DOE

N82-15554# Department of Energy, Washington, D. C. Office of Energy Management and Extension.
ANNUAL REPORT TO THE PRESIDENT AND THE CONGRESS ON THE STATE ENERGY CONSERVATION PROGRAM FOR CALENDAR YEAR 1980
Jul. 1981 40 p
(DE81-025862; DOE/CE-0016) Avail: NTIS HC A03/MF A01

The activities of the fifth year's operation (December 1979 through December 1980) of the state energy conservation program are reported. The program requires states to develop and implement plans that will reduce projected energy consumption by 5% or more in 1980. Five program measures required to be eligible for financial assistance under the plan and three program measures under a supplemental plan are described and outlined. The details of program operation and results to date are reported. Program management in a description of selected innovative state Program measures are described. The President's Program for economic recovery is evaluated. DOE

N82-15555# Pacific Northwest Lab., Richland, Wash.
TECHNOLOGY CHANGE AND ENERGY CONSUMPTION: A COMPARISON OF RESIDENTIAL SUBDIVISIONS
L. A. Nieves and A. L. Nieves 1981 38 p Presented at the 56th Ann. Conf. of the Western Econ. Assoc., San Francisco, 2-6 Jul. 1981
(Contract DE-AC06-76RL-01830)
(DE81-030075; PNL-SA-9049; CONF-810767-2) Avail: NTIS HC A03/MF A01

The energy savings in residential buildings likely to result from implementation of the building energy performance standards (BEPS) were assessed. The goals were to: compare energy use in new homes designed to meet or exceed BEPS levels of energy efficiency with that in similar but older homes designed to meet conventional building codes, and to survey the home owners regarding their energy conservation attitudes and behaviors and to ascertain the degree to which conservation attitudes and behaviors are related to residential energy use. The consumer demand theory which provides the framework for the empirical analysis is presented. The sample residences are described and the data collection method discussed. The definition and measurement of major variables are presented. DOE

N82-15556# Minnesota Geological Survey, St. Paul.
MOORHEAD DISTRICT HEATING, PHASE 2 Final Report
R. E. Sundberg Jan. 1981 429 p refs
(Contract DE-AC02-78CS-20074)
(DE81-029689; DOE/CS-20074/1) Avail: NTIS HC A19/MF A01

The feasibility of developing a demonstration cogeneration hot water district heating system was studied. The district heating system would use coal and cogenerated heat from the Moorhead power plant to heat the water that would be distributed through underground pipes to customers or their space and domestic water heating needs, serving a substantial portion of the commercial and institutional loads as well as single and multiple family residences near the distribution lines. The technical feasibility effort considered the distribution network, retrofit of the power plant, and conversion of heating systems in customers' buildings to use hot water from the system. The system would be developed over six years. The economic analysis consisted of a market assessment and development of business plans for construction and operation of the system. Rate design methodology, institutional issues, development risk, and the proposal for implementation are discussed. DOE

N82-15557# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
MICRO-HYDROPOWER IN THE UNITED STATES
R. O. Haroldsen and F. B. Simpson 1981 9 p refs Presented at WATERPOWER 1981 Conf., Washington, D.C., 22 Jun. 1981
(Contract DE-AC07-76ID-01570)
(DE81-028271; EGG-M-02781; CONF-8106137-5) Avail: NTIS HC A02/MF A01

The interest and problems relating to the development of micro-hydropower, i.e., capacities of less than 100 kW, was assessed. A total of 62 individuals from 10 states and 4 groups, i.e., developers, A/E firms, equipment manufacturers, and state and federal agencies, were polled to determine their perceptions of the advantages and disadvantages of micro-hydro developments and the needs for such developments. Financing, technical assistance, and help with the economic analysis and regulatory aspects of micro-hydro development appeared to be the paramount needs. Whether or not a specific site can be successfully developed depends on site conditions. A micro-hydro plant discussed as

an example is shown to be a poor investment, e.g., maximum $200 per month return on $80,000 investment. DOE

N82-15883# Vereinigte Elektrizitaetswerke Westfalen A.G., Dortmund (West Germany). Bereich Marketing.
ENERGY CONSUMPTION ANALYSIS AND COMPARATIVE STUDY OF THE OPERATIONAL RESULTS FROM HEAT PUMP PLANTS Final Report, Oct. 1979
Peter Mueller, Bernd Bewer, Heinz Klaus, Walter Sander, and Hans Joachim Guenther Wirthwein Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 240 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-109; ISSN-0340-7608) Avail: NTIS HC A11/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 40.50

Electric energy consumption with inclusion of the electricity consumption of the supplementary and auxiliary equipment is considered. Costs are divided into plant costs for heat pumps, heating systems and auxiliary equipment, installation costs for heat pumps, heating systems and auxiliary equipment, operating costs and maintenance costs. Specific energy consumption and cost statements were determined. Operational experiences were reviewed and the energetic operational behavior, including supplementary and auxiliary equipment for a random test of plants, is discussed. Author (ESA)

N82-15889# Mitre Corp., McLean, Va. Metrek Div.
ENERGY AND DEVELOPMENT IN CENTRAL AMERICA. VOLUME 1: REGIONAL ASSESSMENT Final Report, Oct. 1979 - Feb. 1980
Wayne Park, Wayne Park, Carole Neves, Ranvir Trehan, William Gallegher, Phillip Palmedo, Andres Doernberg, Keith Oberg, and Steven Kyle Feb. 1980 128 p refs Prepared in cooperation with Energy/Development International 2 Vol.
(Contract AID/SOD/PDC-C-0146)
(PB81-231540; MTR-80W601-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 10A

A regional energy assessment of six Central American countries is presented. The purpose is to assist these countries in defining, planning, and meeting energy requirements implicit in their economic and social development goals. The following topics are treated: Central America Regional energy assessment; energy issues; geographical, social, and economic aspects; energy resources; current energy use and future energy use; energy strategies. GRA

N82-15890# Mitre Corp., McLean, Va. METREK Div.
ENERGY AND DEVELOPMENT IN CENTRAL AMERICA. VOLUME 2: COUNTRY ASSESSMENTS Final Report, Oct. 1979 - Feb. 1980
Wayne Park, Carole Neves, Ranvir Trehan, William Gallagher, Phillip Palmedo, Andres Doenborg, Keith Oberg, and Steven Kyle Mar. 1980 350 p refs Prepared in cooperation with Energy/Development International 2 Vol.
(Contract AID/SOD/PDC-C-0146)
(PB81-231557; MTR-80W602-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 10A

An energy assessment for each of six Central American countries - Guatemala, El Savador, Honduras, Nicaragua, Costa Rica, and Panama is presented. The program assists the U.S. Agency for International Development and other development organizations in defining energy programs in Central America. The following issues are treated separately for each individual country: geographic, social and economic aspects; energy resources; current and future energy use; energy strategies. GRA

N82-15891# Tata Inst. of Fundamental Research, Bombay (India). Documentation Centre.
INDIAN ENERGY ABSTRACTS
Mar. 1981 46 p
(PB81-232316) Avail: NTIS HC A03/MF A01 CSCL 10A

The document provides abstracting coverage of scientific and technical energy literature originating from Indian Government Departments, Universities, National Laboratories, and other research institutions including industries. The scope encompasses all forms of renewable sources of energy and more efficient and less polluting use of fossil and fissile fuels. DOE

N82-15892# National Academy of Sciences - National Research Council, Washington, D. C. Advisory Committee on Technology Innovation.
SUPPLEMENT TO ENERGY FOR RURAL DEVELOPMENT: RENEWABLE RESOURCES AND ALTERNATIVE TECHNOLOGIES FOR DEVELOPING COUNTRIES Final Report
1981 248 p refs
(Contract AID/TA-C-1433)
(PB81-231011; CIR/BOSTID/38) Avail: NTIS HC A11/MF A01 CSCL 10A

The publication energy for rural development: renewable resources and alternative technologies for developing countries, which presented information on a variety of subjects, including direct uses of solar energy (heating, cooling, distillation, crop drying, photovoltaics), indirect uses of solar energy (wind power, hydropower, photosynthesis, biomass), geothermal energy, and energy storage is reviewed. New technologies developed and advances made in technologies are discussed. GRA

N82-15894# Bureau of the Census, Washington, D. C.
FUELS AND ELECTRIC ENERGY CONSUMED
Feb. 1981 25 p
(PB81-240442; MIC-77-SR-5) Avail: NTIS HC A02/MF A01 CSCL 08I

The following topics on energy consumption are reported: general summary, type of operation, size of establishment, type of organization, assets and capital expenditures, fuels and electric energy consumed, and water use. GRA

N82-15896# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Inst. voor Chemische en Technologische Research.
POLLUTION OF THE SOIL BY AVIATION GASOLINE
A. Verweij Aug. 1979 26 p ref In DUTCH; ENGLISH summary
(Contract A78/KL4/146)
(PML-1979-41; TDCK-73390) Avail: NTIS HC A03/MF A01

A literature search was conducted to determine the effects of aviation gasoline spills and more general oil spills on the environment and on the condition of oil storage tanks. Remedial measures are presented. Attention is given to naturzl restoration processes as well as to actions to speed up these processes. Author

N82-15898# Battelle Pacific Northwest Labs., Richland, Wash.
ECOLOGICAL EFFECTS ASSESSMENT: REQUIREMENTS VS STATE-OF-THE-ART
D. H. McKenzie, J. M. Thomas, and L. L. Eberhardt May 1981 31 p refs Presented at the 3rd Conf. on Waste Heat Management and Utilization, Miami, Florida, 12 May 1981
(Contract DE-AC06-76RL-01830)
(DE81-028092; PNL-SA-9292; CONF-810545-5) Avail: NTIS HC A03/MF A01

Current requirements and the state-of-the-art in ecological effects assessments in regard to nuclear power plants are studied. The current cooling system approaches, data collection programs, and ecological effects assessments are discussed. A timely review and evaluation of current practice is called for. The magnitude of economic and environmental resources being committed to cooling system alternatives mandates that the decision-making process result in as many optimal choices as possible. In addition, the resources being devoted to environmental data collection and integration provide considerable motivation for providing meaningful input to the decision-making process. It is maintained that the input should be as quantitative and as free from subjective content as is reasonably possible. An alternative viewpoint suggests that the past several decades of experience be considered but a first step, and the current task to be one of designing a second step. DOE

N82-15902# California Univ., Livermore. Lawrence Livermore Lab.
THREE-DIMENSIONAL, FINITE ELEMENTAL MODEL FOR SIMULATING HEAVIER-THAN-AIR GASEOUS RELEASES OVER VARIABLE TERRAIN
Robert L. Lee, Philip M. Gresho, Stevens T. Chan, and Craig D. Upson Aug. 1981 17 p refs Presented at the NATO/CCMS 12th Intern. Tech. Meeting on Air Pollution Modeling and its Applications, Menlo Park, Calif., 25-28 Aug. 1981 Submitted for publication

(Contract W-7405-eng-48)
(DE81-028689; UCRL-85520; CONF-810841-1) Avail: NTIS HC A02/MF A01

A 3 dimensional finite element model was developed to predict the dispersion processes associated with heavier than air gaseous releases in the atmosphere. Both 2 dimensional and 3 dimensional examples presented to demonstrate the flexibility of the model in simulating the motion of the vapor cloud generated after a liquid natural gas spill over flat or variable terrain. Also presented are results to justify the slightly more complex generalized anelastic model rather than one employing the Boussinesq and/or hydrostatic approximation, which are routinely used for planetary boundary layer flows but can be inappropriate for this application. DOE

N82-15606# Data Resources, Inc., Lexington, Mass.
REGIONAL LOAD-CURVE MODELS: SCENARIO AND FORECAST USING THE DRI MODEL Final Report
H. D. Platt Aug. 1981 283 p Sponsored by Electric Power Research Inst.
(EPRI Proj. 1008)
(DE81-904192; EPRI-EA-1672-Vol-3) Avail: NTIS HC A13/MF A01

Regional load curve models were constructed for 32 regions that were created by aggregating hourly load data from 146 electric utilities. The forecast scenario is described and the forecast resulting from the use of this scenario is presented. The highlights of this forecast are two observations: first, peak demands will once again become winter phenomena. In the heating season, the model is reponsive to the number of heating degree hours, the penetration rate of electric heating equipment, and the rate at which this space conditioning equipment is utilized. Winter season demands grow more rapidly than demands in other seasons and peaks begin to appear in winter months. Secondly load factors begin to increase in the forecast, reversing the trend which began in the early 1980s. Nationally, load factors do not leap upwards, instead they increase gradually. DOE

N82-15607# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
KINETICS OF REACTIONS IN A WET FLUE GAS SIMULTANEOUS DESULFURIZATION AND DENITRIFICATION SYSTEM
S. G. Chang, D. Littlejohn, and N. H. Lin Jul. 1981 36 p refs Presented at the ACS Symp. on Advan. in Flue Gas Desulfurization, Atlanta, 30 Mar. - 3 Apr. 1981
(Contract W-7405-eng-48)
(DE81-029853; LBL-13063; CONF-810394-1) Avail: NTIS HC A03/MF A01

A number of processes for simultaneous removal of SO2 and NO sub x are discussed. They are based on either the oxidation of relatively insoluble NO to more soluble NO2 or the employment of a water soluble ferrous chelating compound as a catalyst to aid in the absorption of the insoluble NO. These ferrous compounds have the ability to form complexes with the NO and thus promote the absorption of the NO. Once in solution NO sub x can be reduced by the absorbed SO2 to form molecular N2, N2O or reduced nitrogen compounds such as NOH(SO3)2(-2), NH(SO3)2(-2), NH2SO(-) and NH4(+); while SO2 is oxidized to sulfate. The kinetics and mechanisms of reactions involved in this system are discussed. DOE

N82-15608# University of Western Michigan, Kalamazoo. Dept. of Chemistry.
FUNDAMENTALS OF NITRIC OXIDE FORMATION IN FOSSIL-FUEL COMBUSTION Progress Report, 29 Sep. - 28 Dec. 1980
Thomas Houser and Michael E. McCarville Aug. 1981 19 p refs
(Contracts DE-AC21-76ET-10592; EX-76-C-01-2018)
(DE81-030329; DOE/ET-10593/T2; FE-2018-19) Avail: NTIS HC A02/MF A01

The rate and products of oxidation of HCN and the influence of additives, benzene, cyclohexane, toluene, acetylene and CO, on the rate and products were studied. The only significant oxidation products in the absence of additives were CO2, H2O and N2. The complex order indicates that a complex chain mechanism is operating, however, the activation energy appears too large for a chain or surface mechanism. HCN consumption dropped drastically and benzene consumption was reduced a small amount even at higher oxygen concentrations in the reactor. No change in products was observed. It suggested that CO and acetylene produce an intermediate during oxidation that does not form when benzene oxidizes. DOE

N82-15609# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
REAL TIME COARSE PARTICLE MASS MEASUREMENTS IN A HIGH TEMPERATURE AND PRESSURE COAL GASIFIER PROCESS TREATMENT
J. Wegrzyn, J. Saunders, and W. Marlow Mar. 1981 9 p refs Presented at the 3rd Symp. on the Transfer and Utilization of Particulate Control Technol., Denver, 10-12 Mar. 1981
(Contract DE-AC02-76CH-00016)
(DE81-030036; BNL-22952; CONF-810319-3) Avail: NTIS HC A02/MF A01

A probe appropriate for direct extracted sampling of erosive range particulate matter from a coal gasifier outlet or a high pressure fluidized bed combustor. The system consists of four modules: (1) a null balance extraction probe with injection through a porous lined tube to minimize wall loss; (2) a stem type virtual impactor to separate coarse from fine particles; (3) a filter tape collector; and (4) a beta gauge total mass detector. A stem type virtual impactor separates at ambient gas stream conditions the coarse particles from the sampling stream so that at upon filtration no condensible vapors, fine particles or reactive gases pass through the filter tape. DOE

N82-15610# California Univ., Livermore. Lawrence Livermore Lab. Environmental Sciences Div.
ELEMENTAL COMPOSITION OF ATMOSPHERIC FINE-PARTICLES EMITTED FROM COAL BURNED IN A MODERN ELECTRIC POWER PLANT EQUIPPED WITH A FLUE-GAS DESULFURIZATION SYSTEM
J. M. Ondov Jul. 1981 19 p refs Presented at the Am. Chem. Soc. Meeting., Las Vegas, Nev., 1 Dec. 1980
(Contract W-7405-eng-48)
(DE81-030073; UCRL-85035; CONF-801288) Avail: NTIS HC A02/MF A01

Mechanisms of fine particle formation and chemical enrichment in the flue-gas desulfurization system are dicussed. Improved control devices drastically affect the quantity, chemical composition, and physical characteristics of fine particles emitted to the atmosphere from these sources. Fly ash aerosols were sampled upstream and downstream from a modern lime slurry, spray tower system installed on a 430 Mw(e) coal utility boiler. The concentrations of up to 35 elements and estimates of the size distributions of particles in each the fly ash fractions were determined by instrumental neutron activation analysis and by electron microscopy. DOE

N82-15611# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
INDOOR AIR QUALITY
C. D. Hollowell Jun. 1981 13 p refs Presented at the Inst. of Gas Res. Conf., Los Angeles, 28 Sep. - 1 Oct. 1981
(Contract W-7405-eng-48)
(DE81-029857; LBL-12887; CONF-810909-4; EEB-Vent-81-17) Avail: NTIS HC A02/MF A01

Common sources of indoor air pollution in buildings, the specific pollutants emitted by each source, the potential health effects, and possible control techniques are discussed. Rising energy prices, have generated an incentive to reduce ventilation rates and thereby reduce the cost of heating and cooling buildings. Reduced ventilation in buildings increases exposure to indoor air pollution. It is suggested that reduced ventilation adversely affects indoor air quality unless appropriate control strategies are undertaken. The strategies used to control indoor air pollution depend on the specific pollutant or class of pollutants encountered, and differ depending on whether the application is to an existing building or a new building under design and construction. The first course of action is prevention or reduction of pollutant emissions at the source. DOE

N82-15613# Pacific Northwest Lab., Richland, Wash.
ASSESSMENT OF THE LONG-RANGE TRANSPORT OF RESIDENTIAL WOODSTOVE FINE-PARTICULATE EMISSIONS FOR TWO FUTURE UNITED STATES ENERGY

SCENARIOS
K. J. Allwine, Jr. May 1981 17 p refs Presented at the Intern. Conf. on Residential Solid Fuels, Portland, Oreg., 1-4 Jun. 1981
(Contract DE-AC06-76RL-01830)
(DE81-030096; PNL-SA-9806; CONF-810674-5) Avail: NTIS HC A02/MF A01

The impact of solar energy technologies (especially woodstoves) on regional scale fine particulate air quality resulting from direct-energy-use sources was analyzed. It is shown that significant interregional transport of fine particulates occurs especially into the three northeastern regions of the US. It is indicated that concentrations are low relative to any current particulate standards. Both maximums occurred in the Middle Atlantic region. It is predicted that the concentrations in the eastern five regions will decrease from 1975 to 2000 (both scenarios) whereas the opposite is true for the five western regions. The contributions from woodstoves are projected to increase in all regions. The majority of this increase is due to woodstoves. For the three northeastern regions more than 50% of the impact of each region is from outside the respective region. DOE

N82-15618# Battelle Columbus Labs., Ohio.
USE OF COAL CLEANING FOR COMPLIANCE WITH SO2 EMISSION REGULATIONS Final Report, Jun. 1977 - Jun. 1981
E. H. Hall, A. W. Lemmon, Jr., G. L. Robinson, F. K. Goodman, J. H. McCreery, R. E. Thomas, and P. A. Smith Sep. 1981 438 p refs
(Contract EPA-68-02-2163)
(PB81-247520; EPA-600/7-81-146; IERL-RTP-1244) Avail: NTIS HC A19/MF A01 CSCL 13B

Results of an evaluation of coal cleaning as a means of controlling SO2 emissions from coal fired stationary sources are presented. Coal cleaning was examined in the light of various existing and proposed SO2 emissions regulations to determine applications in which the technology would be most useful. Barriers were identified that prevent wider application of coal cleaning. Actions are described which should be taken to overcome these barriers. Much information about coal is compiled as resource data on the coal reserve base, present and projected coal production, coal cleanability, current and projected coal use by utilities and industry, size and age distribution of coal fired facilities, and the nature of coal contracts. Environmental impacts of coal cleaning are compared with those of other sulfur removal strategies such as flue gas desulfurization and the use of low sulfur coal. Similarly, costs of the various SO2 control alternatives are compared. GRA

N82-15621# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.
HEAVY-DUTY ENGINE BASELINE PROGRAM AND NO SUB X EMISSION STANDARD DEVELOPMENT (1972-73)
Timothy Cox, Zachary Diatchun, Thomas Nugent, Glenn Passavant, and Larry Regsdale Mar. 1981 69 p refs
(PB81-244030; EPA-AA-SDSB-81-01) Avail: NTIS HC A04/MF A01 CSCL 13B

The statutory NOx emission standard for 1985 heavy duty engines was determined. The standard is based on a 75% reduction from the average measured emissions for uncontrolled (1972-73 model year) gasoline fueled heavy duty engines program established the amount of NOx emissions from the uncontrolled heavy duty gasoline-fueled engines. A baseline testing this program consists of four sectons: (1) engine procurement; (2) restorative maintenance; (3) testing the engine emission levels by transient test procedure; and (4) determination of the average measured emissions. GRA

N82-15623# Research Triangle Inst., Research Triangle Park, N. C.
SYMPOSIUM PROCEEDINGS: ENVIRONMENTAL ASPECTS OF FUEL CONVERSION TECHNOLOGY, 6TH Progress Report, Feb. - Aug. 1980
F. A. Ayer, comp. and N. S. Jones, comp. Jan. 1981 665 p refs Proceedings of symp. held in St. Louis, 16-19 Sep. 1980
(Contract EPA-68-02-3170)
(PB81-248045; EPA-600/9-81-008) Avail: NTIS HC A99/MF A01 CSCL 13B

Environmental aspects of fuel conversion technology are presented. Environmental information related to coal gasification, indirect liquefaction, direct liquefaction, program approach, environmental assessment, environmental control, and the development of pollution control guidance documents is included. GRA

N82-15624# Geological Survey, Indianapolis, Ind. Water Resources Div.
EFFECTS OF COAL FLY-ASH DISPOSAL ON WATER QUALITY IN AND AROUND THE INDIANA DUNES NATIONAL LAKESHORE, INDIANA Final Water-resources Investigation Report
Mark A. Hardy Apr. 1981 73 p refs
(PB81-239479; USGS/WRD/WRI-81-073; USGS/WRI-81-16) Avail: NTIS HC A04/MF A01 CSCL 13B

Dissolved constituents in seepage from fly ash settling ponds bordering part increased trace elements, and gross alpha and gross beta radioactivity in ground water and surface water downgradient from the settling ponds. It is suggested that concentrations of some dissolved trace element are greater beneath interdunal pond 2 than in the pond. It is found that calcium concentrations are greater in ground water downgradient from the settling ponds than in the ponds. Where organic material is present downgradient from the settling ponds, concentrations of arsenic, fluoride, molybdenum, potassium, sulfate, and strontium were greater in the ground water than in the ponds. In contrast, the concentrations of cadmium, cooper, nickel, aluminum, cobalt, lead, and zinc are less. GRA

N82-15626# TRW, Inc., Research Triangle Park, N.C. Progress Center.
DEMONSTRATION OF WELLMAN-LORD/ALLIED CHEMICAL FGD TECHNOLOGY: DEMONTRATION TEST SECOND YEAR RESULTS Final Report, Feb. 1973 - Oct. 1979
R. C. Adams, S. W. Mulligan, and R. R. Swanson Aug. 1981 410 p refs
(Contract EPA-68-02-3174)
(PB81-246316; EPA-600/7-81-140) Avail: NTIS HC A18/MF A01 CSCL 13B

The performance over a 2 year period of a full scale flue gas desulfurization (FGD) is reported. The process is regenerable, employing sodium sulfite wet scrubbing, thermal regeneration of the spent scrubber solution, and reduction to elemental sulfur of the recovered SO2. Process energy requirements, primarily for thermal regeneration of the scrubber solution and subsequent recovery of SO2, were quite large, amounting to 12 percent of the boiler heat input derived from fuel. Operation and performance occurred after some modification to the boiler to increase inlet flue gas temperature and after implementing FGD plant improvements identified during initial operation. GRA

N82-15633# Los Angeles County Sanitation District, Whittier, Calif.
PARALLEL EVALUATION OF AIR-AND OXYGEN-ACTIVATED SLUDGE Final Report, Feb. 1975 - Dec. 1978
Scott Austin, Fred Yunt, Donald Wuerdeman, and Walter E. Garrison Aug. 1981 53 p
(Contract DI-14-12-150)
(PB81-246712; EPA-600/2-81-155) Avail: NTIS HC A04/MF A01 CSCL 13B

The merits of air and oxygen in the activated sludge process, two 1900-cu m/day activated sludge pilot plant, one air and one oxygen system, were operated. Both of the pilot plants met the applicable discharge limitations for everything but three trace metals, but the oxygen system provided a more stable operation. Primary differences in performance concerned ammonia nitrogen removals and energy consumption. GRA

N82-15637# Energy Resources Co., Inc., Cambridge, Mass.
POTENTIAL ENVIRONMENTAL PROBLEMS OF ENHANCED OIL AND GAS RECOVERY TECHNIQUES Final Report
Ron Beck, Robert Shore, Terry Ann Scriven, and Melinda Lindquist Aug. 1981 297 p refs
(Contract EPA-68-03-2648)
(PB81-240186; EPA-600/2-81-149) Avail: NTIS HC A13/MF A01 CSCL 13B

This report provides: (a) an identification of and analysis of available data regarding EOR/EGR related pollutants; (b) an assessment of potential environmental impacts and an identifica-

tion of possible controls; and (c) recommendations as to research needs. The following processes were studied: steam injection, in situ combustion, carbon dioxide miscible flooding, micellar/polymer flooding, alkaline flooding, improved waterflooding, advanced hydraulic fracturing, chemical explosive fracturing, and directional drilling. The existing EOR/EGR environmental impact information (published and unpublished) is critically reviewed and summarized. The effect of EOR/EGR processes on air quality, groundwater quality, water quantity, noise levels, and secondary impacts is the main area of analysis. GRA

N82-15651# Research Triangle Inst., Research Triangle Park, N. C.
PROCEEDINGS: SYMPOSIUM ON FLUE GAS DESULFURIZATION, VOLUME 1
Franklin A. Ayer Apr. 1981 548 p refs Symp. held at Houston, Tex., 28-31 Oct. 1980
(Contract EPA-68-02-3170)
(PB81-243156; EPA-600/9-81-019A-Vol-1) Avail: NTIS HC A23/MF A01 CSCL 13B

Presentations of the flue gas desulfurization (FGD) conference are presented. They cover such subjects as approaches for control of acid rain, the Nation's energy future, economics of FGD, legislative/regulatory developments, FGD research/development trends, FGD system operating experience, FGD byproduct disposal/utilization, developments in dry FGD, and industrial boiler applications. GRA

N82-15652# Research Triangle Inst., Research Triangle Park, N. C.
PROCEEDINGS: SYMPOSIUM ON FLUE GAS DESULFURIZATION, VOLUME 2
Franklin A. Ayer, comp. Apr. 1981 551 p refs 8th Symp. held at Houston, Tex., 28-31 Oct. 1980
(Contract EPA-68-02-3170)
(PB81-243164; EPA-600/9-81-019B) Avail: NTIS HC A24/MF A01 CSCL 13B

Proceedings on flue gas desulfurization are documented. Presentations covered the following subjects: approaches for control of acid rain, the nation's energy future, economics of FGD, legislative/regulatory developments, FGD research/development trends, FGD system operating experience, FGD byproduct disposal/utilization, developments in dry FGD, and industrial boiler applications. GRA

N82-15833# California Univ., Livermore. Lawrence Livermore Lab.
METHODOLOGY AND BASIC ALGORITHMS OF THE LIVERMORE ECONOMIC MODELING SYSTEMS
Robert B. Bell 17 Mar. 1981 43 p refs
(Contract W-7405-eng-48)
(DE81-029430; UCRL-53131) Avail: NTIS HC A03/MF A01

The methodology and the basic pricing algorithms used in the Livermore economic modeling system (EMS) are described. Each algorithm's function is analyzed and a detailed derivation of the actual mathematical expressions used to implement the algorithm is presented. DOE

N82-16012# Applied Decision Analysis, Inc., Menlo Park, Calif.
EVALUATING R AND D OPTIONS UNDER UNCERTAINTY. VOLUME 2: ATMOSPHERIC FLUIDIZED-BED COMBUSTION COMMERCIALIZATION STRATEGIES Final Report
A. B. Borison, B. R. Judd, P. A. Morris, and E. C. Walters Aug. 1981 79 p Sponsored by Electric Power Research Inst.
(EPRI Proj. 1432-1)
(DE81-904246; EPRI-EA-1964-Vol-2) Avail: NTIS HC A05/MF A01

A quantitative framework for analyzing commercialization decisions for emerging electrical power generation technologies was developed. The framework addresses the general question of when to freeze a design for commercialization. The framework was developed to help evaluate the benefits of continuing the development of two different designs for atmospheric fluidized bed combustion boilers. EPRI staff participated actively in specifying the scope of the analysis and in providing technical information on the two designs. The framework was demonstrated using this information, supplemented with probabilistic judgments by EPRI staff about possible outcomes from the pilot and demonstration stages of development. Based on the technical data and judgments supplied by EPRI staff, the analysis shows a net benefit for proceeding with the development of two designs. DOE

N82-16013# Applied Decision Analysis, Inc., Menlo Park, Calif.
EVALUATING R AND D OPTIONS UNDER UNCERTAINTY. VOLUME 3: AN ELECTRIC-UTILITY GENERATION-EXPANSION PLANNING MODEL Final Report
A. B. Borison, B. R. Judd, P. A. Morris, and E. C. Walters Aug. 1981 114 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1432-1)
(DE81-904237; EPRI-EA-1964-Vol-3) Avail: NTIS HC A06/MF A01

An electric utility generation expansion model developed for use in research and development (R and D) planning under uncertainty is described. The model provides a framework for examining broad utility and R and D planning issues, rather than the specific generation expansion decisions of individual utilities. Unlike existing approaches, the model focuses directly on the demand, technological, and regulatory uncertainties and the long term dynamics that affect the impact of R and D achievements. The model's somewhat aggregate approach to electric utility decision making (to allow repeated application at low cost) can be modified, as needed, for more detailed utility planning. When fully implemented, the model can be applied to the analysis of issues such as technology adoption, reserve margin, unit size, reliability, storage and load management effects, lead time, and government regulation. DOE

N82-16014# Brookhaven National Lab., Upton, N. Y.
APPLICATION OF AN LP MODEL TO STRATEGIC PLANNING OF MULTINATIONAL COOPERATIVE RD AND D PROGRAMS
V. L. Sailor 1981 10 p refs
(Contract DE-AC02-76CH-00016)
(DE81-029325; BNL-29857) Avail: NTIS HC A02/MF A01

An analytical study was initiated to serve as a basis for defining a cooperative strategy for RD and D among International Energy Agency member nations. A flexible energy system model, MARKAL, was developed as the primary tool for the analysis. The flexibility of MARKAL is demonstrated by the fact that the diverse energy systems of sixteen countries and the aggregated European Economic Community have been modeled successfully. MARKAL is a multi-period linear programming model which describes the energy flows, costs, and resource consumption of national energy systems over an extended period of time (1980 to 2020). Various policy options and assumptions about future world situations create a range of scenarios which control the MARKAL solutions. Such options and such postulated conditions, translated into operational indicators to drive the MARKAL model and constrain its solutions, are described. DOE

N82-16022*# National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICS AND SPACE REPORT OF THE PRESIDENT, 1980 ACTIVITIES
1981 108 p
(NASA-TM-84079) Avail: NTIS HC A06/MF A01 CSCL 05A

The year's achievements in the areas of communication, Earth resources, environment, space sciences, transportation, and space energy are summarized and current and planned activities in these areas at the various departments and agencies of the Federal Government are summarized. Tables show U.S. and world spacecraft records, spacecraft launchings for 1980, and scientific payload and probes launched 1975-1980. Budget data are included. A.R.H.

02
SOLAR ENERGY

Includes solar collectors, solar cells, solar heating and cooling systems, and solar generators.

A82-10007 **Solar materials science.** Edited by L. E. Murr (New Mexico Institute of Mining and Technology, Socorro, NM). New York, Academic Press, 1980. 799 p. $35.

Solar collector (photothermal) materials are considered, taking into account the optical properties-microstructure relationship in particulate media, solar mirror materials and their use in solar concentrating collectors, the effect of soiling on solar mirrors and techniques used to maintain high reflectivity, the emissivity of metals, fundamental limits to the spectral selectivity of composite materials, composite film selective absorbers, and corrosion science and its application to solar thermal energy material problems. Solar storage and thermochemical materials are discussed, giving attention to thermal storage in salt-hydrates, a thermodynamic basis for selecting heat storage materials, the application of reversible chemical reactions to solar thermal energy systems, and materials science issues encountered during the development of thermochemical concepts. Solar conversion (photovoltaic) materials are also examined, and a description is provided of research and device problems in photovoltaics, heterojunctions for thin film solar cells, the optimization of solar conversion devices, and the basic aspects of plasma-deposited amorphous semiconductor alloys in photovoltaic conversion. The role of crystal defects in solar materials is studied along with surface and interface characteristics. G.R.

A82-10008 **Introduction to solar materials science.** R. S. Claassen (Sandia Laboratories, Albuquerque, NM) and B. L. Butler (Solar Energy Research Institute, Golden, CO). In: Solar materials science. New York, Academic Press, 1980, p. 3-51. 38 refs. Contracts No. DE-AC04-76DP-00789; No. EG-77-C-01-4042.

A broad program is underway to develop and improve the full range of technologies needed to make solar energy a significant contributor to the U.S. national energy supply. One important aspect of the technology development is materials. Attention is given to solar collector materials, photochemical conversion and storage, and solar conversion materials. Although solar energy systems require no fuel, they are characterized by high initial cost. Cost reduction is, therefore, an essential element of the solar energy program. Concern for cost is reflected in considerations of materials availability, in the development and demonstration of mass production processes which are inherently inexpensive, and in the design of solar energy systems of minimum complexity. G.R.

A82-10009 **Introduction to the role of crystal defects in solar materials.** L. E. Murr and O. T. Inal (New Mexico Institute of Mining and Technology, Socorro, NM). In: Solar materials science. New York, Academic Press, 1980, p. 53-92. 33 refs.

It is pointed out that, to a large extent, the science of materials is dominated by the role of imperfections in determining or controlling the properties of materials. Crystal defects, or imperfections, in crystalline materials are now well documented. In general, they are grouped into regimes of zero-dimensional (or point) defects, one-dimensional (or line) defects, two-dimensional (or planar) defects, and three-dimensional (or volume) defects. Vacancies, interstitials, and substitutional impurities constitute the more common point defects, while charge balance requirements in ionic solids require pairs of such defects to be formed, or some other charge-compensating mechanisms. Dislocations constitute the more common line defects. Attention is given to crystal structures and order-disorder phenomena, crystal lattice defects, and solar-related materials structures. G.R.

A82-10010 **Surface and interface studies and the stability of solid solar energy materials.** A. W. Czanderna (Solar Energy Research Institute, Golden, CO). In: Solar materials science. New York, Academic Press, 1980, p. 93-147. 61 refs. Contract No. EG-77-C-01-4042.

An overview is provided of the role that surface and interface studies of solid materials must play if the U.S. is to achieve wide scale commercialization and application of the various solar technologies. Surface studies applicable to solar materials are considered, taking into account the surface area, real and clean surfaces, structure and topography, surface composition or purity, surface thermodynamics, the equilibrium shape, diffusion, the nature of adsorbate/solid interactions and the amount adsorbed, and the methods used for studying the surfaces of solar materials. The surface science of solar materials surfaces is discussed, giving attention to surface science in energy technologies, areas of surface science and solar energy technologies, and surface science applied to specific solar energy materials. A description is presented of the role of the polypropylene/copper oxide interface in the catalyzed oxidative degradation of polypropylene. G.R.

A82-10011 **The optical properties-microstructure relationship in particulate media - Optical tailoring of solar absorbers.** A. Ignatiev (Houston, University, Houston, TX). In: Solar materials science. New York, Academic Press, 1980, p. 151-170. 28 refs. Research sponsored by the U.S. Department of Energy and University of Houston.

The basic principles of electromagnetic radiation absorption in solids are examined. It is found that a good solar energy absorber should have a metallic or semimetallic component and that the absorber should be composed of small particles. The understanding of the interaction of an array of small conducting particles with electromagnetic radiation is, in this connection, of interest in the study of solar energy absorption. An effective medium theory is considered. The approach used by O'Neill and Ignatiev (1978) is expanded to illustrate the applicability of an approach which involves the definition of distributions of spheroidal particles in the modeling of the optical response of particulate films. The investigation shows that the optical response of solar absorbers is strongly dependent on the microscopic structure of the absorber. It is, therefore, possible to accomplish optical tailoring of a material through the manipulation of its microscopic structure. G.R.

A82-10012 **Solar mirror materials - Their properties and uses in solar concentrating collectors.** R. B. Pettit and E. P. Roth (Sandia Laboratories, Albuquerque, NM). In: Solar materials science. New York, Academic Press, 1980, p. 171-197. 32 refs. Contract No. DE-AC04-76DP-00789.

Solar mirror materials are used in a variety of solar collectors in order to redirect the incident sunlight onto a receiver surface. The collectors employed range from augmented flat plate collectors to high concentration tracking parabolic dish concentrators. The primary advantage in using solar mirrors to concentrate sunlight is either to increase the system efficiency (e.g., be reducing thermal losses) or to reduce the system cost where relatively expensive receiver materials are utilized. In most applications, the total mirror surface area deployed is large. Thus, the mirrors must be manufactured at a relatively low cost. The current state of mirror materials with application to solar concentrators is reviewed. After specular reflectance is defined, the optic ' measurement techniques developed specifically for these materials are discussed. Attention is given to the solar reflectance properties of mirror materials, taking into account glass, metallized plastics, polished aluminum, and protective coatings. G.R.

A82-10013 **The effect of soiling on solar mirrors and techniques used to maintain high reflectivity.** E. P. Roth and R. B. Pettit (Sandia Laboratories, Albuquerque, NM). In: Solar materials science. New York, Academic Press, 1980, p. 199-227. 24 refs. Contract No. DE-AC04-76DP-00789.

Solar mirrors are designed to achieve initially the maximum possible reflectance. However, outdoor exposure subjects the mirror materials to environmental conditions which can quickly reduce their efficiency. One effect of outdoor exposure is the reflectance loss due to the accumulation of foreign particles on the mirror surface. Specular reflectance losses as great as 25% have been observed for mirrors exposed for only a few weeks. Severe energy losses can occur in the case of concentrating collecting systems. Thus, from an

economic point of view, periodic cleaning or reduction of soil accumulation is a practical necessity. Potential methods for controlling the reflectance loss due to soiling must be based on information regarding dust accumulation and its effect on the produced energy. A field test study was initiated simulating some of the operational configurations of solar mirrors to obtain a suitable data base. The accumulation of dust and the resulting loss in specular reflectance was found to be a complex function of mirror material, weather conditions, geographical location, and operational methods. G.R.

A82-10014 **The emissivity of metals.** A. J. Sievers (Cornell University, Ithaca, NY). In: Solar materials science. New York, Academic Press, 1980, p. 229-254. 29 refs. NSF Grant No. DMR-76-81083; Contract No. XH9-8158-1.

It is pointed out that the high-temperature thermal radiative properties of metals were not described correctly until 1978. The early radiant heat transfer models of metals are examined, taking into account model characteristics which do not correspond to the real physical conditions. A description is given of a new model, which describes correctly the temperature-dependent thermal radiative properties of metals. Attention is given to the temperature dependence of the hemispherical emissivity of platinum, high-temperature selective surfaces, aspects of spectral emissivity, questions of total emissivity, the normal spectral emissivity of the Drudy free electron model as a function of frequency, and model corrections. For a correct description of the infrared emissivity of metals, it is necessary to take into account the properties of metal surfaces. G.R.

A82-10015 **Fundamental limits to the spectral selectivity of composite materials.** A. J. Sievers (Cornell University, Ithaca, NY). In: Solar materials science. New York, Academic Press, 1980, p. 255-276. 18 refs. NSF Grant No. DMR-76-81083; Contract No. XH9-8158-1.

Two approaches are considered for absorbing the solar radiation, while suppressing thermal reradiation. According to one approach, the solar radiation is transmitted through a heat mirror to a nonselective absorber. The second approach involves the absorption of solar radiation by a dark mirror which has a small thermal emissivity. The construction of the employed spectrally selective surfaces is very different for each case. The current study is concerned with the relative potential of each of the two approaches, taking into account in both cases the best configuration consistent with physical constraints. Transparent heat mirrors are considered, taking into account the spectral characteristics of conducting meshes. In an investigation of dark mirrors, attention is given to dark metal, metal plus a dielectric film, and metal plus an absorbing film. The relative merits of the two considered approaches depend upon the temperature. Should selective absorber temperatures ever rise above 800 K, the heat mirror may ultimately provide the larger figure of merit. G.R.

A82-10016 **Composite film selective-absorbers.** R. A. Buhrman and H. G. Craighead (Cornell University, Ithaca, NY). In: Solar materials science. New York, Academic Press, 1980, p. 277-317. 17 refs. Research supported by the Solar Energy Research Institute.

A description is presented of the general nature of the optical properties of metal-insulator composite films. Attention is given to the production of composites, the composite microstructure, the Maxwell-Garnett theory, an alternative mean field theory first proposed by Bruggeman (1935), and optical properties observed in experimental studies. Approaches employed to develop a surface which is strongly absorbing over the solar spectrum but nonabsorbing at longer wavelengths are discussed. Figures of merit are considered along with questions regarding the choice of composite absorber components, graded composition coatings, and the production of high temperature selective absorbers. G.R.

A82-10017 **Corrosion science and its application to solar thermal energy material problems.** S. L. Pohlman (Solar Energy Research Institute, Golden, CO). In: Solar materials science. New York, Academic Press, 1980, p. 319-373. 53 refs. Contract No. EG-77-C-01-4042.

Attention is given to problems that may limit the development of solar thermal systems due to material failure. Material degradation in one form or another appears to be a common problem facing the development of solar thermal power. An investigation is conducted of material problems of thermal concentrating systems that employ gas, liquid metal, molten salt, water, or organic fluids as a primary heat transfer fluid. Degradation of the reflective surfaces used to concentrate thermal energy is also considered, and material problems associated with thermal storage are discussed. A review of flat plate collector systems is conducted, and the material problems facing ocean thermal conversion systems are examined. By the application of thermodynamic data, environmental observations, and electrochemical measurements, chemical and mathematical models of corrosion processes can be developed and used to effectively predict corrosion failure. G.R.

A82-10020 **The application of reversible chemical reactions to solar thermal energy systems.** R. Mar (Sandia Laboratories, Livermore, CA). In: Solar materials science. New York, Academic Press, 1980, p. 439-457. 33 refs.

It has been proposed to use reversible thermochemical reactions as a means for storing thermal energy in solar energy systems. The considered approach involves the storage of thermal energy in the form of chemicals created by endothermic reactions. In addition to the storage applications, there is also interest in applying reversible reactions to solar thermal energy transport and solar thermal heat pumping for space heating and cooling systems. A review is provided of all three of these applications. The characteristic features of reversible chemical reaction systems are compared to the properties of sensible and latent heat systems. Preliminary cost/benefit studies show that of the three applications considered solar chemical heat pump systems for space heating and cooling applications are the most attractive. The use of thermochemical reactions strictly for thermal energy storage in solar thermal electric power plants does not appear to be attractive. G.R.

A82-10021 **Materials science issues encountered during the development of thermochemical concepts.** R. Mar (Sandia Laboratories, Livermore, CA). In: Solar materials science. New York, Academic Press, 1980, p. 459-485. 27 refs.

Thermodynamic considerations are to be used for a preliminary screening of reactions for solar energy applications. Attention is given to relations involving the reaction temperature, coupled reaction considerations, and entropy considerations. Reactions which meet the thermodynamic requirements must be evaluated further with respect to technical and economic feasibility. Generic materials problems are examined, taking into account catalyzed reactions, thermal decomposition reactions, and solution-dissolution reactions. Aspects of materials corrosion and compatibility are also discussed along with catalyst development activities. Concerns with catalyzed reaction systems are found to include effects of thermal cycling on reactor materials, catalyst availability and lifetime, and undesirable side reactions. Problems have arisen in thermal decomposition systems due to poor or variable kinetics and volume expansion effects. Reactions which make use of the heat of solution suffer least from materials problems. The major concerns are with the corrosive nature of the chemicals involved. G.R.

A82-10022 **Introduction to photovoltaics - Physics, materials and technology.** L. Kazmerski (Solar Energy Research Institute, Golden, CO). In: Solar materials science. New York, Academic Press, 1980, p. 489-549. 302 refs.

The operational principles and performances of photovoltaic solar cells based on various materials are reviewed. Following a brief introduction to the possible structures and categories of solar cells and the rationale for the development of improved, low-cost variants to the conventional single-crystal Si cell the current-voltage characteristics of a homojunction cell are derived from the materials properties of the device, and the efficiency and equivalent circuits for the device are discussed. The material properties necessary to the functioning of a photovoltaic device are examined, with attention given to the energy gap, absorption coefficient, diffusion length, minority carrier lifetime, doping, surface recombination, and gap state density. Examples of device and materials engineering are presented which illustrate the advancement of solar cell technology. A.L.W.

A82-10023 Research and device problems in photovoltaics. L. Kazmerski (Solar Energy Research Institute, Golden, CO). In: Solar materials science. New York, Academic Press, 1980, p. 551-584. 96 refs.

Current problems in photovoltaic device research are reviewed as they relate to intermediate-efficiency thin-film solar cells and high-efficiency concentrator devices. In the area of thin-film solar cells, efforts have been centered on the improvement of materials and device properties for devices based on amorphous silicon, polycrystalline silicon, thin-film GaAs, and CdS, with emphasis on problems associated with the grain boundaries and degradation mechanisms, and on the identification and demonstration of new photovoltaic materials including InP, CdTe, Cu2O, Zn3P2, Cu2Se, ZnSiAs2, CdSiAs2, BAs and polyacetylene. Devices under development for high-efficiency solar concentrators include the multidevice, beam-splitting photovoltaic convertors, monolithic multijunction solar cells, and the edge multiple vertical junction device. A.L.W.

A82-10024 Heterojunctions for thin film solar cells. R. H. Bube (Stanford University, Stanford, CA). In: Solar materials science. New York, Academic Press, 1980, p. 585-618. 33 refs. Research supported by the U.S. Department of Energy and Solar Energy Research Institute.

The basic properties of semiconductor heterojunctions and heteroface junctions are discussed in relation to their use in solar cells. The types of measurements that are used in the characterization of an experimental heterojunction cell are considered, including measurements of the bulk properties of the component materials, the crystallographic structure of component materials, the effects of surface treatments on material properties, contact resistivities, dark and light current-voltage characteristics, light diode parameters, the spectral dependence of quantum efficiency, reverse breakdown voltage, the light intensity dependence of cell parameters, junction capacitance, electron-beam induced current, photoluminescence and electroluminescence, chemical composition and interface structure. Band diagrams are then presented for heterojunctions composed of a highly conducting p-type optical absorbing window material and a highly conducting n-type window material on a less conducting p-type absorber, which are illustrated by the Cu2S/CdS and CdS/CdTe heterojunctions, respectively. The fabrication and characteristics of CdS/CdTe, CdS/InP, and ZnO/CdTe heterojunctions, MIS and SIS devices, and sputtered ITO/CdTe and ITO/InP buried homojunctions are then examined in detail. A.L.W.

A82-10025 The optimization of solar conversion devices. D. S. Ginley, M. A. Butler, and C. H. Seager (Sandia Laboratories, Albuquerque, NM). In: Solar materials science. New York, Academic Press, 1980, p. 619-664. 40 refs. Contract No. DE-AC04-76DP-00789.

The direct and indirect application of simple chemical potential and electronegativity arguments to photoelectrochemical cells (PEC) and thin-film polycrystalline semiconductors - systems seen as having considerable potential for solar energy conversion - is discussed. It is shown how the principal criteria of the cells can be determined. Particular attention is given to the biasing requirements of these cells, and to this end an electronegativity model is presented that can be used to predict biasing requirements on a quantitative basis. Attention is also given to the energy levels in silicon grain boundaries and to the double-depletion-layer, thermal-emission model of conduction over the potential barrier in the boundary. Also discussed are recent results demonstrating that various chemical agents, when appropriately introduced into silicon grain boundaries, are capable of modifying grain boundary potential barriers. C.R.

A82-10026 Introduction to basic aspects of plasma-deposited amorphous semiconductor alloys in photovoltaic conversion. R. W. Griffith (Brookhaven National Laboratory, Upton, NY). In: Solar materials science. New York, Academic Press, 1980, p. 665-731. 75 refs. Research sponsored by the U.S. Department of Energy.

The progress that has been made in advancing an understanding of the materials properties of plasma-deposited a-Si:H alloys is reviewed. The nature of the plasma is discussed, proceeding from preliminary concepts of the RF glow discharge to a more detailed description of the plasma chemistry in the silane glow discharge. Experience gained with plasma etching is briefly reviewed as a paradigm for plasma deposition. Emitting reactive species that are identified in plasma deposition using optical emission spectroscopy are discussed, and electron-impact processes that are pertinent to the silane glow discharge are summarized. In addition, the characterization of plasma-deposited silicon-hydrogen alloys is analyzed. The introduction given to chemical bonding consists of discussions of short-range structural order, the role of hydrogen in the alloy, and the influence of residual gap states upon diode characteristics. C.R.

A82-10331 Alternative power sources for residential air-conditioning systems. J. Tiran (Negev, University, Beersheba, Israel). *Applied Energy*, vol. 9, Oct. 1981, p. 121-130. 8 refs.

An integrated system which utilizes three sources of energy for the purpose of air-conditioning a residential building is considered. The system includes a control unit which determines (according to a built-in programmed logic) which energy source is to be used. The system's three power provisions are: (1) line electricity, (2) electric power generated by an appropriate wind turbine and (3) a hot water system heated by solar collectors. System requirements and operation were simulated by a computer program which calculated the air-conditioning load and the energy provisions throughout a twenty-four hour period. In winter operation, about 68 per cent of the required heating was supplied by solar heating and 32 per cent by wind-generated power and in summer operation, in a typical day, all the required cooling energy was provided by wind-generated power. (Author)

A82-10385 Prospects for the development of solar energy in the USSR - Production of electric power by thermodynamics methods. R. R. Aparisi, Iu. N. Malevskii, B. V. Tarnizhevskii, V. K. Gusev, and A. M. Karpenko (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow; Teploelektroproekt; Sel'energoproekt, USSR). *(Geliotekhnika*, vol. 16, no. 6, 1980, p. 3-10.) *Applied Solar Energy*, vol. 16, no. 6, 1980, p. 1-8. 6 refs. Translation.

Tower solar power plants, pumped storage to level off the intermittency of the energy source, and parabolic dish concentrators for low power users in the U.S.S.R. are discussed. Capital expenditures and energy efficiency of solar plants are composed with conventionally fueled power plants, deriving baseline economic parameters which justify solar plant construction. Initial plans are presented for the installation of 5 - 10 MW units in rural areas of low generating capacity remote from conventional fuel sources, using mirrors optimized at 25 sq m and equipped with automatic tracking systems. Plants in Kazakhstan are considered for powering deep well irrigation and desalinization of the mineral-rich water. The development of new energy storage capabilities is considered vital to successful introduction of large solar power plant capacities. M.S.K.

A82-10386 Some characteristics of silicon photocells fabricated by planar technology. C. Tkhong, K. A. Tyan, P. V. Khoi, and L. K. Nam (National Center Branch for Scientific Research of Vietnam, Ho Chi Minh City, North Vietnam). *(Geliotekhnika*, vol. 16, no. 6, 1980, p. 18-21.) *Applied Solar Energy*, vol. 16, no. 6, 1980, p. 15-18. 8 refs. Translation.

It is reported that a method for determining the effective diffusion length on the basis of the spectral distribution curve for the collection coefficient permits a qualitative evaluation of the nonequilibrium distribution of recombination centers in the base layer. (Author)

A82-10387 Present state of research on selective coatings for solar-energy converters. M. M. Koltun (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *(Geliotekhnika*, vol. 16, no. 6, 1980, p. 34-42.) *Applied Solar Energy*, vol. 16, no. 6, 1980, p. 30-38. 42 refs. Translation.

Recent developments in selective surface coatings for solar cells, flat plate and tubular collectors, and parabolic concentrators are reviewed. Solar cells treated with hydrazine hydrate or alkalies produce a surface with relief, which traps up to 97% of the spectrum. Multilayer cells transparent to the IR are noted for space applications; phosphor coatings to convert ultraviolet radiation to visible light are mentioned for use as light and radiation detectors, expanding the range into the 0.2-0.4 micron wavelengths. Coating compounds for cell protection are presented, noting a trend toward

polymer films, silicon varnish, and coatings with microrelief to enhance cell efficiencies. Processes for electrochemical plating of thermal collector surfaces are listed, including black nickel and chrome, as are various reflective coatings for thermal radiators. The development of cermets for high IR transparency is discussed, noting that cermets extend the absorptance/emmissivity ratio to 60-65. Finally, tin oxides employed for solar cell antireflective coatings are observed to reduce surface recombination rates in silicon cells.

M.S.K.

A82-10388 Investigation of abrasive action of atmospheric particles on the reflectance of mirrors. R. A. Zakhidov and A. Ismanzhanov (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). *(Geliotekhnika,* vol. 16, no. 6, 1980, p. 43-47.) *Applied Solar Energy,* vol. 16, no. 6, 1980, p. 39-43. 9 refs. Translation.

Atmospheric dust, its particle sizes, and wind-blown effects on solar power plant mirrors are investigated. Experiments were performed with particles from 5-200 microns at wind tunnel speeds of 2-30 m/s, encountering a protected or uncoated aluminum mirror. Wind speed, mirror angle and dust size and concentration per volume air were varied and mirror reflectance, diffuse reflectance, rear reflection, and light transmission through various protective coatings were measured after 60 hrs bombardment. Damage was related to wind speed, with all dust sizes causing damage when wind exceeded 30 m/s. Mirror angles of 90 and 0 deg relative to the wind eliminated damage up to 30 M/s, and SiO2 coatings were found to offer protection up to a 30 deg angle. The experiments indicate that mountain-valley air circulation presents no danger to mirrors, whereas areas of frequent jet winds and loose soil do. M.S.K.

A82-10389 Experimental investigation of parabolic-cylinder solar concentration with tubular heat receiver. M. A. Markman, N. V. Kolomoets, L. M. Simanovskii, Iu. I. Shmatok, and O. P. Zakharova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *(Geliotekhnika,* vol. 16, no. 6, 1980, p. 66-68.) *Applied Solar Energy,* vol. 16, no. 6, 1980, p. 61-63. Translation.

The performance and characteristics of an electroplated anodized aluminum parabolic concentrator with a tubular heat receiver are described. A 2-sq-m sheet of aluminum was elastically deformed into a concentrator with a 400-mm focal length; the heat receiver was a blackened metal tube enclosed in a fluorescent light tube. Focusing errors were determined by use of a collimated light beam shone perpendicular to the receiver window, and optical efficiency and heat receiver losses were calculated and graphed as functions of temperature. The total flux was determined by calorimetry of water flowing through the receiver tube and by measuring the temperature of the heat receiver directly; predicted values for the flux agreed satisfactorily with the experimental findings. M.S.K.

A82-10390 Regime characteristics of a solar thermoelectric generator and comparison of experimental and calculated data. E. A. Movsumov and A. M. Bairamov (Kirovabadskii Pedagogicheskii Institut, Kirovabad, Azerbaidzhan SSR). *(Geliotekhnika,* vol. 16, no. 6, 1980, p. 69, 70.) *Applied Solar Energy,* vol. 16, no. 6, 1980, p. 64-66. 7 refs. Translation.

Experiments undertaken to verify predicted solar thermoelectric generator performance are described. The powder metallurgy process for production of Bi-Te-Se-negative and Bi-Te-Sb positive legs of the thermoelectric generator is reviewed, as is the fabrication of the generator; illuminance, varied according to flux data from the Azerbaidzhan SSR, was provided by a searchlight with a focal-spot maximum heat of 300 C. Volt-ampere characteristics of the thermopiles were determined for various temperature differentials, and the efficiencies were calculated. Both capacity and efficiency were found to rise linearly with increasing temperature. Performances determined from simulation of three actual 12-hour periods agreed well with predicted values. M.S.K.

A82-10391 Electrical characteristics of high-voltage germanium photoconverters under high illumination intensities. D. S. Strebkov, V. A. Tikhomirova, and G. B. Fedosova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *(Geliotekhnika,* vol. 16, no. 6, 1980, p. 71-73.) *Applied Solar Energy,* vol. 16, no. 6, 1980, p. 67-69. 6 refs. Translation.

Germanium matrix photoelectric cells were tested in 0.1-5 W/ sq cm illumination to characterize their electric properties. Cell specimens were moved along the optical axis of a Fresnel lens under 600 W illumination to vary the light intensity, and output was compared with a linearly varying short-circuit current of a standard silicon cell. Examination of volt-ampere characteristics revealed that low resistance (0.1 ohm cm) germanium cells displayed a linear photocurrent dependence over the illuminance range explored, while higher resistivity (10 ohm cm) produced nonlinear behavior at around 3 W/sq cm and upward. The behavior is attributed to a voltage drop in the base region of the cell. Efficiency was found to reach a maximum at 1 W/sq cm, falling off thereafter. A 6.5% maximum efficiency was found for 10 ohm cm germanium cells. M.S.K.

A82-10467 Optical properties of selectively absorbing chromium films deposited at oblique angle of incidence. R. T. Kivaisi (Institute of Optical Research, Stockholm, Sweden). *Solar Energy Materials,* vol. 5, Aug. 1981, p. 115-127. 23 refs.

Optical properties of chromium films deposited at oblique angles of incidence are studied, and consideration is given to their being used as selective films in photothermal solar energy conversion. The films were produced on smooth glass substrates by subliming chromium pellets from an electron beam gun in a conventional oil diffusion pumped system in high vacuum. A graphical relationship between film thickness and reflectance was obtained, and coatings with the desired selectivity were produced. Some films were deposited on nickel and aluminum metal backing. A near to zero reflectance (0.9 microns) of a film coated on an aluminum substrate corresponded to a film thickness of 110 nm, the coating having a solar absorptance of about 86%. It is thought that the coating contains a high concentration of metal grains, each surrounded by a very thin film of chromium oxide. It is concluded that the emissivity of the surfaces is primarily determined by the base metal. K.S.

A82-10468 Spectrally selective copper sulphide coatings. S. B. Gadgil, R. Thangaraj, J. V. Iyer, A. K. Sharma, B. K. Gupta, and O. P. Agnihotri (Indian Institute of Technology, New Delhi, India). *Solar Energy Materials,* vol. 5, Aug. 1981, p. 129-140. 9 refs. Research supported by the Tata Energy Research Institute.

Copper sulfide films are chemically deposited on aluminum substrates in ambient air by chemical spray deposition, and their optical properties are studied for their application in solar energy photothermal conversion. The experimental procedure is described, including the deposition technique, structural studies (using an X-ray diffractometer and a transmission electron microscope), stagnation temperature measurements, and aging tests. It is shown that (1) the solar absorptance and solar emittance of the films do not change after cycling between 0 and 200 C, and (2) the films withstand temperatures as high as 200 C for more than 500 h. Solar selectivity with maximum solar absorptance (0.89) and minimum thermal emittance (0.25) is obtained for a film deposited at 250 C with a volume ratio of 1:1 of thiourea and cupric acetate solutions, and a thickness of 1.6 microns. It is concluded that the films provide a low cost ($2.5/sq m) selective coating for photothermal conversion of solar energy. K.S.

A82-10469 Effect of metal base layer on the absorptance and emittance of sputtered graded metal-carbon selective absorbing surfaces. G. L. Harding and S. Craig (Sydney, University, Sydney, Australia). *Solar Energy Materials,* vol. 5, Aug. 1981, p. 149-157. 17 refs. Research supported by the University of Sydney.

Solar absorptance and temperature-dependent emittance is measured for graded metal-carbon films deposited onto smooth aluminum, copper, nickel, and stainless steel base layers, sputter-deposited onto glass tubes at relatively low argon pressure (approximately 0.5 Pa), and deposited onto textured copper using argon pressures 3 to 40 Pa. Absorptance measurements are made on surfaces deposited onto small plane glass slides attached to a glass tube in the coating system, and emittance measurements are made on coated tubes, assembled into glass envelopes. Both the small planar specimens of selective surface and coated tubes were inserted in continuously evacuated glass envelopes and annealed at 500 C for approximately 1 hr. It is shown that solar absorptance varies by only 1-2% for the different base layers, whereas the emittance of surfaces based on nickel and stainless steel is considerably higher than for

surfaces based on copper and aluminum. Small changes occur in absorptances and emittances after annealing. It is concluded that the optimum selective surface for evacuated collectors used with mirrors of low concentrations consists of graded metal-carbon overlaid with smooth copper. K.S.

A82-10471 Production of alloys of bismuth telluride for solar thermoelectric generators. T. Durst, H. J. Goldsmid, and L. B. Harris (New South Wales, University, Kensington, Australia). *Solar Energy Materials*, vol. 5, Aug. 1981, p. 181-186. 9 refs.

A simple and inexpensive method is described for the preparation of sintered thermoelements for use up to about 200 C, i.e., within the temperature range that is accessible using nontracking solar collectors. The method involves selecting the raw materials, weighing the constituents and melting the ingots, grinding and grading the powders, cold-pressing the thermoelements, sintering, and evaluating the thermoelectric properties. It is shown that p-type Bi(0.5)Sb(1.5)Te(3) containing 0.05% atomic Pb, and n-type B(2)Te(2.7)Se(0.3) containing 0.2% atomic S are most suitable for operation between 30 and 170 C (i.e., at a mean temperature of 100 C). The Seebeck coefficient, electrical conductivity, and figure of merit are measured between 15 and 200 C using apparatus based on Harman's technique (1958), account being taken of radiation losses. It is shown that even though the thermoelements are porous, their thermoelectric figures of merit compare well with the values obtained with hot-pressed material of higher density. Thermoelements prepared by the method described have been fitted into a solar generator which has been operated for six months without any signs of aging. K.S.

A82-10472 Solution grown PbS/CdS multilayer stacks as selective absorbers. G. B. Reddy, V. Dutta, D. K. Pandya, and K. L. Chopra (Indian Institute of Technology, New Delhi, India). *Solar Energy Materials*, vol. 5, Aug. 1981, p. 187-197. 16 refs.

Theoretical and experimental studies are reported for the design and fabrication of multilayer stacks for selective solar absorbers (25 x 25 sq cm) of PbS and CdSm made on Ni coated Cu and stainless steel, using a solution grown technique. A mathematical model is formulated using the matrix multiplication method to calculate the reflectance of the absorbers. The preparation technique involves dissociating thiourea in an alkaline solution containing Pb or Cb salts, as reported by Sharma et al. (1976) and Kaur et al. (1980). The best values of solar absorptance and thermal emittance obtained are 0.92 and 0.12, respectively, which is in close agreement with the estimated values. Coatings with as many as six alternate layers of PbS and CdS have been made. K.S.

A82-10658 Numerical simulation of solar cell open circuit voltage decay. L. Castañer, J. Llaberia, J. Garrido, and E. Vilamajó (Barcelona, Universidad Politécnica, Barcelona, Spain). *Electronics Letters*, vol. 17, Oct. 1, 1981, p. 745-747. 8 refs.

A82-10776 Laser bonded n-GaAs/p-GaSb heterojunction intercell Ohmic contact. H. T. Yang and S. W. Zehr (Rockwell International Microelectronics Research and Development Center, Thousand Oaks, CA). *Applied Physics Letters*, vol. 39, Oct. 15, 1981, p. 634-636. 7 refs. Contract No. XS9-8058-2.

A method is described for forming an n-GaAs/p-GaSb heterojunction intercell Ohmic contact by a pulsed Nd:glass laser (1.06 micron wavelength) bonding procedure. High quality subcell assemblies of appropriate band-gap are fabricated individually and are used to form a metallurgical bond. The method avoids the need of total lattice matching throughout the structure of a stacked multicolor solar converter. K.S.

A82-10810 Boiling flow instability of a fixed mirror distributed focus solar receiver. S. M. Cho, L. D. Clements, J. D. Reichert (Texas Tech University, Lubbock, TX), and T. T. Kao. *(American Institute of Chemical Engineers and American Society of Mechanical Engineers, National Heat Transfer Conference, 20th, Milwaukee, WI, Aug. 2-5, 1981.) AIChE Symposium Series*, vol. 77, no. 208, 1981, p. 302-311. 10 refs. Contract No. EY-76-C-04-3737.

A fixed mirror distributed focus (FMDF) solar thermal electric power plant concept has been developed. The FMDF system consists of fixed spherical mirror arrays (collector), movable receiver (boiler), receiver support and two-axis gimballing mechanisms, auxiliary heat storage system, and turbine-generator equipment. The FMDF concept has been adopted for a five(5)-MWe solar gridiron project for the city of Crosbyton, Texas. A review is provided of the basic, steady-state, thermal hydraulic performance characteristics of the FMDF receiver. Two types of boiling flow instability are considered, including a static instability and a dynamic instability. Approaches for stabilizing unstable boiling flow are also considered, taking into account the use of variable ID tubes and the employment of intermediary plenums in the boiling circuit. G.R.

A82-10836 # Optical degradation of antireflective silica film on solar collector windows. C. T. Solaga (Commonwealth Scientific and Industrial Research Organization, Div. of Mineral Chemistry, Port Melbourne, Victoria, Australia). *Applied Optics*, vol. 20, Oct. 15, 1981, p. 3464, 3465. 6 refs.

It is reported that a sustained accumulation of contaminants on antireflective silica film-coated solar collector glass could lead to increased reflection losses that could be deleterious to collector efficiency, particularly in environments with high atmospheric pollution levels. Infrared absorption studies of the eluted material have demonstrated that the change in reflectance of the coated surface is caused, for the most part, by adsorption of airborne contaminants onto the negatively charged, high specific area presented by the close-packed, 10-20 nm diam silica spheres forming the antireflective film. O.C.

A82-10969 # AAI Corporation receiver design experience in concentrating solar collectors. H. A. Wilkening, Jr. (AAI Corp. Baltimore, MD). *American Society of Mechanical Engineers, Joint Pressure Vessels and Piping, Materials, Nuclear Engineering and Solar Conference, Denver, CO, June 21-25, 1981, Paper 81-Sol-1*. 5 p. Members, $2.00; nonmembers, $4.00.

The design of concentrating solar collectors requires careful attention to the receiver if maximum theoretical efficiencies are to be achieved. Innovative design concepts and detailed analysis are required if the design goals are to be met at a reasonable cost. This paper examines typical design parameters and shows how they relate to actual field tested hardware. Design criteria such as producibility, selective coating, and absorber material, are discussed. Several practical applications are then examined in detail. Operational experience of both tracking and fixed receivers is reviewed. The applications discussed are industrial hot water and heating and cooling. The special problems of combined photovoltaic and thermal receivers are included. (Author)

A82-10970 # Development of a solar thermal central heat receiver using molten salt. T. R. Tracey (Martin Marietta Aerospace, Denver, CO). *American Society of Mechanical Engineers, Joint Pressure Vessels and Piping, Materials, Nuclear Engineering and Solar Conference, Denver, CO, June 21-25, 1981, Paper 81-Sol-2*. 4 p. Members, $2.00; nonmembers, $4.00. Research supported by the U.S. Department of Energy.

The development and test of a 5 MWth solar heat receiver using a molten nitrate salt (60 percent NaNO3, 40 percent KNaNO3) as the heat transfer fluid is described. The application of the receiver concept in a central receiver solar power system is explained. The advantages of using molten nitrate salts as the receiver heat transfer fluid and the storage fluid are discussed. The problems associated with the receiver development including the need for high temperatures and combinations of creep and fatigue in the receiver tubes are discussed. Our approach to scaling from the 5 MWth test receiver to commercial receivers in the range of 200 MWth to 500 MWth is defined. The 5 MWth test system is described including the instrumentation used. The test facility which has a 60 m tower and 222 heliostats is described. The test results are presented. The receiver was in test for 500 hr at temperature and heat flux levels expected in commercial receiver systems. (Author)

A82-10971 # Testing of the U.S. Solar Pilot Plant receiver. G. C. Coleman (McDonnell Douglas Corp., Huntington Beach, CA) and J. M. Friefeld (Rockwell International Corp., Canoga Park, CA). *American Society of Mechanical Engineers, Joint Pressure Vessels and Piping, Materials, Nuclear Engineering and Solar Conference,*

Denver, CO, June 21-25, 1981, Paper 81-Sol-3. 4 p. Members, $2.00; nonmembers, $4.00.

Preconstruction tests were conducted of the external, single-pass-to-superheat water/steam receiver of the U.S. DOE Solar Thermal Pilot Plant at Barstow, CA under actual solar operating conditions in order to validate the design at the earliest possible date. Receiver steady-state and transient operating characteristics and performance were investigated under three different conditions: (1) clear day, (2) intermittent cloud, and (3) a simulated emergency situation. The testing program was concluded with limited testing of the receiver at flux and power levels above the maximum expected operating conditions. Attention is given to boiler temperature control, lateral flux gradients, panel tube thermodynamics, and dynamic flow stability. O.C.

A82-10972 # The development and design of steam/water solar receivers for commercial application. O. W. Durrant, T. J. Capozzi, and R. H. Best (Babcock and Wilcox Co., Barberton, OH). *American Society of Mechanical Engineers, Joint Pressure Vessels and Piping, Materials, Nuclear Engineering and Solar Conference, Denver, CO, June 21-25, 1981, Paper 81-Sol-4.* 11 p. 7 refs. Members, $2.00; nonmembers, $4.00.

A steam/water solar receiver is described which is designed in sectionalized form, with modularized components, so that it may be assembled in various sizes, capacities and geometries to meet the specific requirements of a system and the characteristics of the solar collector field. Special design features are incorporated to overcome the lack of balance in north-to-south field flux ratios, the effect of partial and transient cloud patterns, and a large number of thermal cycles. A parametric study aimed at the determination of the maximum allowable heat flux on the heat transfer surface components is also described. Attention is given to such aspects of the design as the screen tubes, and calculations and analyses are included for pressure and thermal stresses, heat transfer surface structure, acceptance criteria, and the effects of cloud cover. O.C.

A82-10973 # Conceptual design of an advanced water/steam receiver for a solar thermal central power system. S. F. Wu, T. V. Narayanan (Foster Wheeler Development Corp., Livingston, NJ), and D. N. Gorman (ARCO Ventures Co., Denver, CO). *American Society of Mechanical Engineers, Joint Pressure Vessels and Piping, Materials, Nuclear Engineering and Solar Conference, Denver, CO, June 21-25, 1981, Paper 81-Sol-5.* 9 p. 5 refs. Members, $2.00; nonmembers, $4.00. Research supported by the U.S. Department of Energy.

This paper describes the conceptual design of an advanced water/steam receiver for a commercial-scale solar central receiver thermal power system. The objective was to develop a receiver concept featuring an optimum combination of cost, performance, and reliability. While interfaces with other major subsystems of the complete power plant were recognized, emphasis was on the design and performance of the receiver. The baseline thermal rating of this receiver was 550 MW, and the steam outlet conditions were 12,860 kPa and 516 C. After technical and economic evaluations, a quad-cavity, natural-circulation concept was selected as the preferred receiver design. It consists of four separate cavities in a single receiver unit, each cavity receiving concentrated solar energy from one quadrant of a surrounding heliostat field. (Author)

A82-11185 Carrier-collection efficiencies in amorphous hydrogenated silicon Schottky-barrier solar cells. P. Viktorovitch, G. Moddel, J. Blake, and W. Paul (Harvard University, Cambridge, MA). *Journal of Applied Physics*, vol. 52, Oct. 1981, p. 6203-6207. 28 refs. Contracts No. EG-77-C-01-4042; No. N00014-75-C-0648.

Correlations are studied in the collection efficiency, collection length, depletion width, and midgap density of states and energy-band gaps in sputter and silane-decomposition-produced amorphous hydrogenated silicon Schottky diodes. Collection efficiency is controlled by field associated diffusion of carriers and the depletion region, and midgap-state density decreases with preparation-condition variations to produce wider bandgaps. Sputter-produced films have a collection length which is less than the depletion width, and films produced from the plasma decomposition of silane exhibit a smaller-state density for a given bandgap and a collection length equal to the depletion width. In addition, the weak variation of the deduced hole mobility lifetime product with midgap state density and temperature is consistent with holes immobilized before recombining. D.L.G.

A82-11187 Infrared quenching of photocapacitance in Cu/x/S/CdS solar cells. T. Suda and R. H. Bube (Stanford University, Stanford, CA). *Journal of Applied Physics*, vol. 52, Oct. 1981, p. 6218-6223. 20 refs. Research supported by the U.S. Department of Energy and Japan International Cooperation Agency.

A technique for infrared quenching of photocapacitance (PHCAP-IR) is used to investigate deep Cu-acceptor levels in Cu(x)S/CdS solar cells prepared by both wet and dry methods on CdS single crystals. A theory is developed which describes a doping profile and PHCAP-IR quenching to obtain energy levels, photoionization cross sections, and concentration profiles of Cu levels in CdS. Two transitions of 1.08 and 0.86 eV are measured at room temperature, and the photocapacitance quenching level of 0.86 eV is found to disappear at low temperatures. Spectral distributions of photoionization cross sections are obtained at a peak value of 1.1 x 10 to the -16th sq cm, and the doping profile of Cu indicates that a density of Cu up to one-half of the majority-carrier density diffuses into CdS after heat treatments at 200 C for a few minutes. D.L.G.

A82-11189 Vertical solar cell and internal electric field. Y.-T. Tang (National Tsinghua University, Hsinchu, Republic of China). *Journal of Applied Physics*, vol. 52, Oct. 1981, p. 6347-6351. 17 refs.

A method for estimating the pattern of the built-in electric field distribution in a vertical solar cell is developed that relies on the fact that a vertical solar cell responds differently to different monochromatic light. The usefulness of the technique for quality control is discussed. B.J.

A82-11190 The contoured-oxide monolithic series-array solar battery. E. M. Murray (Hewlett-Packard Laboratories, Palo Alto, CA) and R. M. Warner, Jr. (Minnesota, University, Minneapolis, MN). *Journal of Applied Physics*, vol. 52, Oct. 1981, p. 6352-6356. 7 refs.

The paper presents the monolithic series-array solar battery, which combines integrated circuit and solar battery technology to trade current for voltage and increase the flexibility of the photovoltaic system design. The flexibility holds over a wide range of incident power densities, and the battery offers cost and reliability benefits. The feasibility of the contoured-oxide approach is demonstrated, and power conversion efficiencies of 7.5% are exhibited. The low value is attributed to high series resistance caused by a process omission. Shunting, which is attributable to poor device isolation, is discussed, and corrective modifications are suggested. D.L.G.

A82-11207 Simple tracking strategies for solar concentrations. A. W. G. Cope and N. Tully (Natal, University, Durban, Republic of South Africa). *Solar Energy*, vol. 27, no. 5, 1981, p. 361-365. 6 refs.

Consideration is given to the validity of single axis tracking systems for solar concentrators of low to medium concentration ratios having moderate acceptance angles. If the misalignment between the sun and reflector normals is within the acceptance angle perfect tracking can be assumed. Rotation about a fixed polar axis gives a constant misalignment equal to the sun's declination angle on that day. Rotation about a declination axis gives perfect alignment at noon, but increasing misalignment towards each end of the day varying with the time from the equinoxes. Data is also given for monthly adjustment of the declination axis. All the results are indeoendent of latitude. (Author)

A82-11209 Design and testing of a uniformly illuminating nontracking concentrator. A. Gupta, S. Kumar, Mr. Murlidhar, and V. K. Tewary (Birla Institute of Technology and Science, Pilani, India). *Solar Energy*, vol. 27, no. 5, 1981, p. 387-391. Research supported by the Ministry of Industrial Development.

The transverse parabolic shape of the reflecting surface in the Winston nontracking solar concentrator has been modified so that the illumination at the receiver is exactly uniform for certain angles of incidence, and reasonably uniform for other angles. An exact mathematical expression has been derived for the transverse shape of the reflecting surface, which reduces to the Winston parabolic shape in the limit of extreme nonuniformity. The performance of the

proposed design has been analysed theoretically as well as tested experimentally. Experimental studies show that the illumination at the receiver remains uniform to within 10-12% with no lateral shadows throughout a typical solar day. The proposed design should therefore be quite suitable for photovoltaic applications. D.L.G.

A82-11210 Modeling and testing a salt gradient solar pond in northeast Ohio. S. A. Shah, T. H. Short, and R. P. Fynn (Ohio Agricultural Research and Development Center, Wooster, OH). *Solar Energy*, vol. 27, no. 5, 1981, p. 393-401. 21 refs.

A82-11211 Focal plane flux distributions produced by solar concentrating reflectors. J. A. Harris and W. S. Duff (Colorado State University, Fort Collins, CO). *Solar Energy*, vol. 27, no. 5, 1981, p. 403-411. 5 refs.

A new method is proposed for computing focal plane flux distributions from solar concentrators of parabolic trough, parabolic dish, linear Fresnel, and circular Fresnel geometries. The method is based on efficient numerical equations and allows for the reflecting surface quality and concentrator contour accuracy. Computer implementation of the proposed flux models makes it possible to use mathematical programming techniques that can search a large parameter space for optimum concentrator/absorber designs. V.L.

A82-11212 The effect of inclination on the heat loss from flat-plate solar collectors. P. I. Cooper (Commonwealth Scientific and Industrial Research Organization, Div. of Mechanical Engineering, Highett, Victoria, Australia). *Solar Energy*, vol. 27, no. 5, 1981, p. 413-420. 9 refs.

The top loss coefficient is calculated for single glazed flat-plate collectors as a function of plate temperature, wind speed, ambient temperature, and plate emittance for a typical spacing and an angle of inclination of 45 deg. The sky temperature is assumed to be 12 C below ambient temperature, and an effective sink temperature is defined for top losses from the collector. It is found that the value of the top loss coefficient is insensitive to the effective sink temperature and that the effective temperature is determined solely by the wind speed for a given collector inclination. It is also shown that there is a continual reduction in the top loss coefficient up to an inclination of 90 deg. V.L.

A82-11213 Performance analysis of d.c.-motor-photovoltaic converter system. II - Series and shunt excited motors. J. Appelbaum (Tel Aviv University, Tel Aviv, Israel). *Solar Energy*, vol. 27, no. 5, 1981, p. 421-431.

A82-11214 * An experimental study of SO3 dissociation as a mechanism for converting and transporting solar energy. J. H. McCrary, G. E. McCrary (New Mexico State University, Las Cruces, NM), T. A. Chubb (U.S. Navy, Naval Research Laboratory, Washington, DC), and Y. S. Won (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Solar Energy*, vol. 27, no. 5, 1981, p. 433-440. 6 refs. Research supported by the U.S. Department of Energy.

The high temperature catalytic dissocation of SO3 is an important chemical process being considered in the development and application of solar-thermal energy conversion, transport, and storage systems. A facility for evaluating chemical converter-heat exchangers at temperatures to 1000 C with high flow rates of gaseous SO3 feedstock has been assembled and operated on the NMSU campus. Several quartz and metal reactors containing different catalyst configurations have been tested. Descriptions of the test facility and of the reactors are given along with a presentation and discussion of experimental results. (Author)

A82-11215 Plutonium thermochemical solar cell. G. L. Silver (Monsanto Research Corp., Mound Facility, Miamisburg, OH). *Solar Energy*, vol. 27, no. 5, 1981, p. 443, 444. 9 refs. Contract No. DE-AC04-76DP-00053.

An electrical energy producing cycle is proposed which uses aqueous plutonium as its working fluid. The principle of the proposed cycle is that more work can be extracted from a process which reduces plutonium at constant acidity form N1 to N2 (N1 is greater than N2) than is required to reoxidize the plutonium from N2 to N1 at some lower value of the acidity. The operation of a cell in which one half is a plutonium solution and the other half is a normal hydrogen electrode is described. V.L.

A82-11334 Investigations of the OCVD transients in solar cells. L. Castañer, E. Vilamajó, J. Llaberia, and J. Garrido (Barcelona, Universidad Politécnica, Barcelona, Spain). *Journal of Physics D - Applied Physics*, vol. 14, Oct. 14, 1981, p. 1867-1876. 12 refs.

A theoretical analysis of the OCVD transients in solar cells has been done taking into account capacitive effects affecting the decay. An experimental method is described which improves the accuracy of measurements. Numerical and experimental verification of the predicted results is also described. (Author)

A82-11343 Stability of n-i-p amorphous silicon solar cells. D. L. Staebler, R. S. Crandall, and R. Williams (RCA Laboratories, Princeton, NJ). *Applied Physics Letters*, vol. 39, Nov. 1, 1981, p. 733-735. 12 refs. Contract No. ET-78-C-03-2219.

Unencapsulated, amorphous silicon indium tin oxide/n-i-p/stainless-steel solar cells were tested for stability. All cells have excellent shelf life. Changes occur during exposure to light, but can be controlled by the deposition conditions of the amorphous silicon. The changes are due to trapping and recombination of optically generated carriers in the i layer, and are reversibly annealed out above 175 C. Preliminary life tests on two relatively stable cells showed a small initial drop to 5%, followed by a weak logarithmic decay that predicts only about 20% further decrease in efficiency after 20 years in sunlight. Work is continuing on improving the efficiency and stability of these cells. (Author)

A82-11344 Efficient Si solar cells by low-temperature solid-phase epitaxy. B.-Y. Tsaur, G. W. Turner, and J. C. C. Fan (MIT, Lexington, MA). *Applied Physics Letters*, vol. 39, Nov. 1, 1981, p. 749-751. USAF-supported research.

Solid-phase epitaxial Si layers of uniform thickness have been grown at 400-500 C by transport of Si atoms from an amorphous Si film through an Al film deposited on 100 line-type single crystal or polycrystalline n-type Si substrates. The epitaxial Si layers are strongly p type due to Al doping, and good rectifying junctions are formed between these layers and substrates. Solar cells with conversion efficiences at AM1 of 10.4 and 8.5% have been fabricated on 100 line-type Si and polycrystalline Si substrates, respectively, without the use of an antireflection coating or back-surface field structure. (Author)

A82-11386 A novel latent heat storage for solar space heating systems - Refrigerant storage. N. R. Sheridan (Queensland, University, Brisbane, Australia) and S. C. Kaushik. *Applied Energy*, vol. 9, Nov. 1981, p. 165-172. 7 refs. Research supported by the Australian Research Grants Committee and University of Queensland.

This paper proposes a novel latent heat storage which is applicable to solar space heating systems. The device is similar to an absorption refrigerator and stores liquid refrigerant which is subsequently evaporated to release the latent heat. It will recover the energy in a heat pump mode for application to solar space heating systems which are seen to be more cost effective - and hence to have a better market potential - than space cooling systems. (Author)

A82-11387 Efficiency of Fresnel lenses. P. Kumar Gupta (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 9, Nov. 1981, p. 173-183. 5 refs.

The efficiency of Fresnel lenses is discussed with respect to optical (reflection and transmission) losses. The efficiencies of lenses of different step widths, i.e., 2, 3, 4 and 5 mm, are the same (91.9%) in the case of reflection losses, and the maximum efficiency of a lens of 5 mm step width is 95.8% with respect to transmission losses. K.S.

A82-11390 Geometrical optical performance studies of a composite parabolic trough with a fin receiver. S. S. Mathur, T. C. Kandpal, R. N. Singh, and A. K. Singhal (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 9, Nov. 1981, p. 223-229.

The geometrical optical performance characteristics of a composite parabolic trough (CPT) with a fin receiver have been studied. The variation of geometrical concentration ratio with mirror element

size and the rim angle of the parent parabola has been studied and the results are presented graphically. The distribution of local concentration ratio over the receiver plane has also been determined for some typical concentrator designs. (Author)

A82-11421 Analysis of power, mass, and size parameters of solar vapor-turbine two-circuit systems with organic working bodies. V. A. Grilikhes, M. M. Grishutin, and V. S. Evseev. *(Geliotekhnika,* no. 1, 1981, p. 5-14.) *Applied Solar Energy,* vol. 17, no. 1, 1981, p. 3-11. 11 refs. Translation.

The power efficiency, mass and sizing parameters of two-circuit solar vapor-turbine systems based on an organic working fluid are analyzed. Calculations are performed for systems using a diphenyl mixture as the working fluid and incorporating a jet condenser which condenses the flowing vapor and acts as a heat pump with two-stage refrigeration and heat removal by radiation. Expressions for the power efficiency and the specific radiator area (with respect to useful electric power delivered) are derived in terms of radiator emittance and efficiency, mechanical pump power required, pump efficiency, adiabatic temperature drop and the thermal balance equation, and it is shown that these parameters depend on the jet condenser parameters. Estimates of the effects of vapor flow pressure and the temperature of the liquid upon entry to the jet condenser on system efficiency and specific area are then presented, and an alternative to the device considered which overcomes its limitations of high specific radiator area by the division of vapor flow into two parts following first-stage regeneration is presented. Calculations show that the jet condenser is capable of providing the required circulation in both systems. A.L.W.

A82-11422 Cascade photogenerators based on silicon and germanium matrix photoconverters. D. S. Strebkov, V. A. Tikhomirova, and G. B. Fedosova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *(Geliotekhnika,* no. 1, 1981, p. 21-23.) *Applied Solar Energy,* vol. 17, no. 1, 1981, p. 18-20. Translation.

The construction of a cascade solar array based on silicon and germanium matrix-type solar cells is reported. Arrays were connected in parallel according to the criterion of equal operating voltages under optimal loads in each stage, and in series according to the criterion of the equality of operating currents, based on measurements of the volt-ampere characteristics of the devices. Measured photocurrents produced under illumination by a tungsten lamp at an irradiance of 0.1 W/sq cm indicate improvements in efficiency relative to the most efficient single material (silicon) amounting to 2% for the germanium irradiated through silicon, and 35-40% for germanium irradiated directly. It is pointed out that the present devices may be useful as photocells with a wide band of spectral sensitivity. A.L.W.

A82-11423 Effect of inhomogeneous flow distribution in a system of heat-generating solar collectors. S. I. Smirnov, Iu. A. Konstantinovskii, and A. S. Torshin (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *(Geliotekhnika,* no. 1, 1981, p. 24-28.) *Applied Solar Energy,* vol. 17, no. 1, 1981, p. 21-24. Translation.

Consideration is given to the effects of a nonuniform distribution of the heat-carrying fluid flow rates in an array of identical solar collectors connected in parallel on the heat output of the array. An expression is derived for the factor by which total heat output in uniform flow differs from that in nonuniform conditions in terms of water inflow and outflow rates from the separate collectors. Calculations show that for a given flow rate through the array, heat output decreases with increasing flow nonuniformity, however significant decreases in output are only produced at very large flow nonuniformities. Results are presented of experimental measurements of heat output from an array of ten parallel branches containing four collectors each and operating at different flow rates which confirm the theoretical results. A.L.W.

A82-11424 Combined solar-energy converters with selective coatings. M. M. Koltun (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *(Geliotekhnika,* no. 1, 1981, p. 54-60.) *Applied Solar Energy,* vol. 17, no. 1, 1981, p. 48-54. 25 refs. Translation.

The role of selective optical coatings in increasing the efficiency of combined solar energy converters, which may consist of two or more devices operating on the same physical principle in different spectral regions, or two energy conversion devices based on different principles, is discussed. Consideration is given to uses of specially designed selective coatings to improve the efficiencies of cascade solar cells, photovoltaic/thermal solar energy converters, which produce both heat and electricity simultaneously, and thermophotoelectric converters, which transform thermal radiation into electrical energy using narrowband semiconductors. It is concluded that, partly due to the use of selective coatings, combined solar energy converters appear to be the most suitable for future solar energy research. A.L.W.

A82-11425 Efficiency of selective surfaces for solar thermal collectors. R. A. Zakhidov, A. Abdurakhmanov, and Sh. I. Klychev (Akademiia Nauk Uzbekskoi SSR, Spetsial'noe Proektno-Konstruktorskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). *(Geliotekhnika,* no. 1, 1981, p. 61-66.) *Applied Solar Energy,* vol. 17, no. 1, 1981, p. 55-60. Translation.

A82-11541 Solar energy technology - A five-year update. M. K. Simmons (General Electric Co., Schenectady, NY). In: Annual review of energy. Volume 6. Palo Alto, CA, Annual Reviews, Inc., 1981, p. 1-42. 143 refs.

Major developments and trends in the field of solar energy in the past five years are reviewed. The tremendous growth in both the intensity and diversity of solar energy research and development projects is illustrated by the growth of government funding in the past decade. Attention is then given to the major directions and objectives of technology advances in the areas of solar and wind resource assessment, low temperature systems including the flat-plate solar collector and storage technology, medium-temperature systems with sunlight concentration for industrial applications, thermal electric and high-temperature systems including the 10 MW(e) pilot plant under construction in Barstow, California, wind energy, biomass production and conversion, photochemical and photovoltaic conversion, ocean thermal energy conversion, and satellite power systems. The rapid, however uneven, growth in the application of solar technology to water and space heating, utilization, and wind and photovoltaics in electricity generation is considered, and future prospects for solar technologies in light of commercial, political, social, and environmental concerns are discussed. A.L.W.

A82-11710 * # A solar simulator-pumped gas laser for the direct conversion of solar energy. W. R. Weaver (NASA, Langley Research Center, Hampton, VA) and J. H. Lee (Vanderbilt University, Nashville, TN). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 84-88. 12 refs. Grant No. NCC1-8.

Most proposed space power systems are comprised of three general stages, including the collection of the solar radiation, the conversion to a useful form, and the transmission to a receiver. The solar-pumped laser, however, effectively eliminates the middle stage and offers direct photon-to-photon conversion. The laser is especially suited for space-to-space power transmission and communication because of minimal beam spread, low power loss over large distances, and extreme energy densities. A description is presented of the first gas laser pumped by a solar simulator that is scalable to high power levels. The lasant is an iodide C3F7I that as a laser-fusion driver has produced terawatt peak power levels. G.R.

A82-11711 # A spacecraft thermophotovoltaic power source with thermal storage. J. G. Severns and M. H. Cobble. In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 89-94. 18 refs.

A solar fired thermophotovoltaic space power supply with thermal storage is proposed. A method is described for estimating component sizes for a given orbit and required load. The well known efficiency enhancement obtainable from a selective radiator is utilized with an Er2O3 radiator used with a germanium photovoltaic.

The possibility of using Yb2O3 with a silicon cell is pointed out, but the high radiator temperatures required make its compatibility with thermal storage doubtful. Temperature difference required to conduct the necessary thermal loads into and through the thermal storage vessel are approximated for two different examples: an oxide eutectic, Al2O3-BeO, melting at 2108 K and silicon melting at 1685 K. The highest delta T values needed for a 1 kW rated supply is 166 K. A cassagrain/solar concentrator is described for this application, the major causes of spread of the solar image at the absorbing aperture are discussed and their importance ranked. (Author)

A82-11712 * # Direct conversion of light to radio frequency energy. J. W. Freeman and S. Simons (Rice University, Houston, TX). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 95, 96. Research supported by the Brown Foundation of Houston; Grant No. NAG3-29.

A description is presented of the test results obtained with the latest models of the phototron. The phototron was conceived as a replacement for the high voltage solar cell-high power klystron combination for the solar power satellite concept. Physically, the phototron is a cylindrical evacuated glass tube with a photocathode, two grids, and a reflector electrode in a planar configuration. The phototron can be operated either in a biased mode where a low voltage is used to accelerate the electron beam produced by the photocathode or in an unbiased mode referred to as self-oscillation. The device is easily modulated by light input or voltage to broadcast in AM or FM. The range of operation of the present test model phototrons is from 2 to 200 MHz. G.R.

A82-11736 * # High power solar array switching regulation. D. K. Decker, J. Cassinelli (TRW Defense and Space Systems Group, Redondo Beach, CA), and M. Valgora (NASA, Lewis Research Center, Cleveland, OH). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 224-231.

It is pointed out that spacecraft utilization projections for the 1980s and beyond show a trend toward extended lifetimes and larger electric power systems. The need for improved power management and energy transfer arising in connection with this trend has resulted in the conduction of a Solar Array Switching Power Management study. A description is presented of initial development work performed in the study, taking into account the characteristics for three mission classes. Attention is given to the manned LEO platform (250-kW average load), the unmanned GEO platform (50-kW average load), and an ion propulsion orbit transfer vehicle (50- to 250 kW load). G.R.

A82-11738 # Series vs. shunt regulators for power control in satellite power systems. J. R. Sheie, R. E. Corbett, and M. C. Glass (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1.
New York, American Society of Mechanical Engineers, 1981, p. 235-240.

The relative advantages and disadvantages of the series and shunt power-control approaches for various applications are examined, including high and low power and high and low earth orbit. A comparative study of the series and shunt power-control techniques is carried out, with consideration given to solar array sizing, power-control weight, equipment heat dissipation, power availability, and electromagnetic interference characteristics. A trade study example is given for specific applications where cost is the evaluation criterion. C.R.

A82-11741 * # Cost and performance projections for SPS photovoltaic blankets. J. A. Scott-Monck (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1.
New York, American Society of Mechanical Engineers, 1981, p. 255-260. 12 refs.

An estimate, based on optimistic projections of current technology, is given for the specific power of photovoltaic blankets which might be achieved if the SPS concept was to be implemented. A simultaneous consideration of cost and technical requirements is used to identify key blanket technologies which must be developed for this reference system. The terrestrial photovoltaic experience coupled with new technology is used to develop cost estimates for the blanket, assuming an annual demand of 5 GW and a manufacturing industry dedicated to blanket production. The results indicate that blanket specific power goals may be exceeded, but there is little prospect that the cost goals can be met. This argues for a reconsideration of the photovoltaic option based on more expensive but higher performance blankets. (Author)

A82-11742 # Satellite power systems /SPS/ energy conversion and power management. A. A. Nussberger (Rockwell International Corp., Space Operations and Satellite Systems Div., Seal Beach, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 261-265.

Impacts on the reference concept resulting from alternatives to microwave conversion, photovoltaic techniques, solar concentration ratio and power distribution voltage are discussed. Alternatives include solid state RF conversion such as sandwich configurations and end-mounted antenna configurations, and magnetron RF conversion including advanced pivoting panel configurations. Mass estimates are compared to a normalized point (2.3 kg/kw), and it is found that the estimates have grown over the past six years by a factor of 2.3 for the reference GaAs concept and 3.5 for the reference silicon concept. Mass savings from the use of multi bandgap solar cells is shown at an efficiency of 30%, and it is concluded that the advance magnetron concept incorporating improvements from evolving technology developments can provide a very competitive program. D.L.G.

A82-11758 * # High performance silicon solar arrays employing advanced structures. D. E. Rockey (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), J. M. Hedgepeth, and L. Adams (Astro Research Corp., Carpinteria, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1.
New York, American Society of Mechanical Engineers, 1981, p. 374-379. 7 refs. Contract No. NAS7-100.

Specific design features to reduce cell mass, lower panel operating temperatures, and improve power to mass ratios for silicon solar cell arrays in space applications are presented. Because mass constraints limit payload capacity for launch into GEO, graphite/epoxy structures combined with high performance Si cells are needed to deliver a power/mass ratio of 265 W/kg, notably for Solar Electric Propulsion systems, compared with existing level of 65 W/kg. Shallow diffusion and back surface field cell technology have raised cell efficiencies to 15%, with a back emissivity of 1.64. Structural design requirements comprise Shuttle interface compatibility, full ground test capability, low mass, and high stiffness. Three array alternatives are discussed, and the STACBEAM configuration, which consists of a triangular truss and a piston deployer with folding accomplished on simple hinges, provides 0.2 Hz stiffness and achieves the design power/mass goals. D.H.K.

A82-11759 # Solar panel current degradation factors. M. T. Gates (Hughes Aircraft Co., Culver City, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 380-382.

Degradation factors that cause current losses distributed unequally over a string of solar cells in series are discussed. A high efficiency solar cell type is used for the investigation with computer simulations to calculate the expected current losses incurred. The study includes analyses of flat panel loss, short circuit current loss in folded cell strings, and folding loss in strings at various operating voltages. Results show that the actual current loss for many conditions is nearly linear with respect to the percent of the string covered, and for voltages at or near the maximum power voltages, and losses are linear even at 5% darkening. D.L.G.

A82-11761 * # Nonimaging concentrators for photovoltaic arrays in space. R. Winston, P. Greenman (Chicago, University, Chicago, IL), and D. Rockey (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 390-392. 8 refs. Research supported by the California Institute of Technology.

Two stage concentrators are studied in order to design an optimum concentrator for photovoltaic arrays in space. The study is directed at designs with two-dimensional geometries because they are better suited to moderate concentrations of about 10 X to 50 X, and because the instantaneous flux distribution is more uniform. It is found that with an f/0.5 primary, where f is the focal length of the primary, the flux distribution is very smooth regardless of the angle of incidence of the radiation. As the focal ratio is increased, peaks in the distribution begin to appear. The nonuniformities can be reduced by introducing small, closely spaced distortions into the reflecting surfaces, and practical arrays can achieve a concentration of 10 when the acceptance half angle is 4.25 deg or 50 when the acceptance half angle is + or - 1 deg. D.L.G.

A82-11762 * # High- and low-resistivity silicon solar cells. A. Meulenberg, Jr. and R. A. Arndt (COMSAT Laboratories, Clarksburg, MD). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 397-399. 13 refs. Research sponsored by the Communications Satellite Corp.; Contracts No. NAS3-21280; No. NAS3-22217.

Attention is given to recent work at COMSAT Laboratories on improving silicon solar cell efficiencies and open-circuit voltages for both high (more than 1000 ohm-cm) and low (less than 1 ohm-cm) resistivities. It is noted that open-circuit voltages above 650 mV have been obtained for 0.1 ohm-cm cells and that air mass zero efficiencies of 12.5% have been measured from 4-mil 1,250 ohm-cm. C.R.

A82-11763 * # Solar cell development for the Power Extension Package. C. R. Baraona (NASA, Lewis Research Center, Cleveland, OH) and J. L. Cioni (NASA, Johnson Space Center, Houston, TX). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 400-403. 6 refs.

The Power Extension Package (PEP), a 32-kilowatt, flexible-substrate, retrievable solar array system for use on the Space Shuttle, is described. It is noted that solar cell costs will be reduced by increasing cell area and simplifying cell and coverglass fabrication processes and specifications. The tests that have been carried out on the cells are described, among them a unique radiation damage test and a side-by-side comparison of candidate cell types with pre- and post-irradiation airplane calibration of outer space short-circuit current. C.R.

A82-11764 # Thin cells - Their present status and future areas of development. J. H. Wohlgemuth (Solarex Corp., Rockville, MD). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 404-408. 10 refs.

Silicon solar cells as thin as 50 microns are fabricated with AMO efficiencies greater than 15%. A chemical etching method is used on thin regular silicon wafers to reduce them to the required thicknesses. The production of textured thin cells, gridded back contact thin cells, and vertical junction thin cells is reviewed, and future possibilities of enhancing cell performance are discussed. D.L.G.

A82-11765 * # Gallium arsenide solar cells-status and prospects for use in space. H. W. Brandhorst, D. Flood, and I. Weinberg (NASA, Lewis Research Center, Cleveland, OH). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 409-415. 27 refs.

Gallium Arsenide solar cells now equal or surpass the ubiquitous silicon solar cells in efficiency, radiation resistance, annealability, and in the capability for producing usable power output at elevated temperatures. NASA has developed a long-range research and development program to capitalize on these manifold advantages. In this paper we review the current state and future prospects for R&D in this promising solar cell material, and indicate the progress being made toward development of GaAs cells suitable for a variety of space missions. Results are presented from studies which demonstrate conclusively that GaAs cells can provide a net mission cost and weight savings for certain important mission classes. (Author)

A82-11766 # GaAs solar cells for space application. G. S. Kamath (Hughes Research Laboratories, Malibu, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 416-421.

It is noted that the status of GaAs solar cells for space power applications has been greatly enhanced by recent developments. Techniques for the large-scale development of space-qualified cells have been perfected at Hughes Research Laboratories using liquid phase epitaxial methods. GaAs cells have been produced with large areas (2 x 4 sq cm) and with reduced thickness (less than 2 mils); the power capacity of these cells is fully equal to the conventional 2 cm x 2 cm cell previously produced. It is noted that in addition to the higher efficiency of the GaAs cells in comparison with silicon, they also have increased radiation hardness to most radiation. It is pointed out that the cost of Ga has come down from $3/g in 1960 to $0.50 in 1980. It is concluded that GaAs is a viable candidate for solar cell application in space power systems and that the advances to date justify their use for specific missions, even at today's cost. C.R.

A82-11767 * # High efficiency thin-film GaAs solar cells. S. Zwerdling, K. L. Wang, and Y. C. M. Yeh (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 422-427. Research sponsored by the U.S. Department of Energy, U.S. Air Force, and NASA.

The paper demonstrates the feasibility of producing high-efficiency GaAs solar cells with high power-to-weight ratios by organic metallic chemical vapor deposition (OM-CVD) growth of thin epi-layers on suitable substrates. An AM1 conversion efficiency of 18% (14% AM0), or 17% (13% AM0) with a 5% grid coverage is achieved for a single-crystal GaAs n(+)/p cell grown by OM-CVD on a Ge wafer. Thin GaAs epi-layers OM-CVD grown can be fabricated with good crystallographic quality using a Si-substrate on which a thin Ge epi-interlayer is first deposited by CVD from GeH4 and processed for improved surface morphology. D.L.G.

A82-11769 * # Power management of multi-hundred kilowatt spacecraft power systems. D. K. Decker, G. W. Fleck (TRW Defense and Space Systems Group, Redondo Beach, CA), and J. Graves (NASA, Marshall Space Flight Center, Huntsville, AL). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 434-439.

A NASA-sponsored study of space power distribution system technology is in progress to develop an Autonomously Managed Power System (AMPS) for large space power platforms. The conceptual design of a 250 kW photovoltaic power system, including the power management subsystem (PMS), is presented. A PMS concept is derived based on the need to accommodate the increased complexity of a utility-type power system, and to minimize Shuttle resupply and ground station operational costs. The main PMS functions are discussed along with the control strategies of the autonomously managed power system. (Author)

A82-11772 # The evaluation of four solar-array-powered multi-kW power conditioners for Space Shuttle Orbiter application. M. C. Wright (Lockheed Engineering and Management Services Co., Houston, TX). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings.

Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 451-456. 6 refs.

The performance of solar-array-powered multikilowatt power conditioners for application on the Space Shuttle Orbiter Power Extension Package (PEP) is evaluated. The application, application requirements, and performance test results are discussed. The PEP goals and requirements are thought to be attainable by utilizing existing power conditioning technology. C.R.

A82-11773 # The Texas Instruments Solar Energy System development. E. L. Johnson (Texas Instruments, Inc., Dallas, TX). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 798-804. Contract No. DE-AC01-79ER-10000.

The system is described, showing that energy conversion and storage functions are combined in a novel way. Here, small silicon solar cells are immersed in an electrolyte and the current generated by the cells is used directly to electrolyze a halogen acid, for example, HBr. The hydrogen and bromine produced can be stored separately until needed and then recombined in a fuel cell to give electrical energy on demand. The fuel cell HBr product is returned to the solar chemical convertor, thus completing the closed loop energy cycle. In summarizing the achievements to date, it is noted that feasibility demonstration of a 13% array electrical efficiency prepared by a laboratory process and 10% array efficiencies have been obtained from potentially scalable solar cell and array processes. C.R.

A82-11778 # Small sodium sulfur battery for solar and wind energy systems. H. J. Haskins and A. G. Domaszewicz (Ford Aerospace and Communications Corp., Aeronutronic Div., Newport Beach, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 836-840. Contract No. DE-AM02-79CH-10012.

A conceptual design of a 1 MWh sodium-sulfur storage battery is given. The battery is to be used in small (15 kW), stand-alone solar or wind electrical power systems. The design uses approximately 1,400 sodium-sulfur cells of a new, high energy capacity configuration. The cells are connected in a parallel/series network to give a discharge voltage of 120 VDC minimum, and with sufficient cell redundancy for a 10 year battery life. A description is given of the battery structure, thermal enclosure, and controls. Battery performance estimates are given, including the effect of thermal losses. It is concluded that sodium-sulfur batteries hold promise for good performance and reliability in small, stand-alone power systems. C.R.

A82-11780 # Molten salt thermal energy storage subsystem for Solar Thermal Central Receiver plants. P. B. Wells (Martin Marietta Aerospace, Denver, CO) and G. P. Nassopoulos (American Technigaz, Inc., Hingham, MA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 925-930. Research supported by the U.S. Department of Energy.

The development of a low-cost thermal energy storage subsystem for large solar plants is analyzed. Molten nitrate salt is used as both the plant's working fluid and as the storage medium. The storage system comprises a specially designed hot tank to hold salt at a storage temperature of 839 K (1050 F) and a separate carbon steel cold tank to hold the salt after its thermal energy has been extracted to generate steam. The hot tank is lined with insulating firebrick to lower the shell temperature to 561 K (550 F) so that a low-cost carbon steel shell can be used. A preliminary design is described for a large commercial-size plant (1200 MWht). Also described are a laboratory test program for the critical components and the design, construction, and test of a small-scale research experiment at the Central Receiver Test Facility in Albuquerque, New Mexico. C.R.

A82-11781 # Ground-mounted thermal storage for the parabolic dish solar collector/Stirling engine system. R. J. Copeland, J. Ullman (Solar Energy Research Institute, Golden, CO), and J. W. Leach (North Carolina State University, Raleigh, NC). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 935-940. 5 refs.

Several types of pumped-fluid thermal energy transport and phase-change thermal storage systems are examined. The pumped fluid circulates through a symmetrically arranged group of collectors within a large collector field and transports thermal energy to the engine/thermal storage subsystem near the center of the connected cluster. Cost analyses are made on the basis of variations in the designs of the major components. Pressurized liquid transport fluids and saturated liquids that boil in the solar receiver to return as vapors are investigated. A number of liquid metals are considered for each type of thermal energy transport. Conventional insulation and vacuum-jacketed multilayer foil type insulation designs are assessed. Also investigated are tube-intensive and direct-contact type heat exchangers. C.R.

A82-11793 # Advances in photovoltaics R&D - An overview. L. L. Kazmerski (Solar Energy Research Institute, Golden, CO). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1637-1641. 35 refs.

Solar cells based upon polycrystalline and amorphous Si, CdS, GaAs, and emerging materials are covered for thin film applications. In the context of the discussion, a thin-film solar cell is one whose active layer is near the minimum required for adequate current collection. Therefore, 50-100 micrometers of polycrystalline Si can be defined as thin film, in contrast to 1-10 micrometers of amorphous Si. A description is provided of highly efficient, nonconventional approaches to concentrator cell applications, taking into account developments in the cell fabrication and module demonstration areas. G.R.

A82-11794 # The development of high efficiency cascade solar cells - An overview. M. L. Timmons, J. A. Hutchby, S. M. Bedair, and M. Simons (Research Triangle Institute, Research Triangle Park, NC). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1642-1644. 9 refs. Research supported by the Solar Energy Research Institute and U.S. Air Force.

Multiple junction solar cells offer potential efficiencies much higher than single junction cells. These high efficiencies are achieved by minimizing the heat losses. Two approaches of utilizing multiple junctions have been demonstrated experimentally. The two approaches are related to spectral splitting and the tandem cell concept. The limiting factor of spectrum splitting is the cost of the reflective filter. The tandem cell technology is new, and device areas are still quite small. G.R.

A82-11795 # Research activities of solar cells in ROC. H. L. Hwang (National Tsinghua University, Hsinchu, Republic of China) and C. Y. Sun (Industrial Technology Research Institute, Hsinchu, Republic of China). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1645-1648. 24 refs.

Silicon solar cell research is considered, taking into account the preparation of a Schottky-barrier silicon solar cell with the aid of an electroless plating process, silicon epitaxial layers grown by chemical vapor deposition (CVD), and ion-implantation techniques employed to fabricate silicon grating-type solar cells. Research on alternative solar cells is also reported. Organometallic CVD has been used in the fabrication of a Cu2S/CdS solar cell. Investigations regarding CuInS2 as a new photovoltaic material are discussed. G.R.

A82-11796 * # Multijunction high voltage concentrator solar cells. G. J. Valco, V. J. Kapoor (Case Western Reserve University, Cleveland, OH), J. C. Evans, and A.-T. Chai (NASA, Lewis Research Center, Cleveland, OH). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1649-1653. NASA-supported research.

The standard integrated circuit technology has been developed to design and fabricate new innovative planar multi-junction solar cell chips for concentrated sunlight applications. This 1 cm x 1 cm cell consisted of several voltage generating regions called unit cells which were internally connected in series within a single chip resulting in high open circuit voltages. Typical open-circuit voltages of 3.6 V and short-circuit currents of 90 ma were obtained at 80 AM1 suns. A dramatic increase in both short circuit current and open circuit voltage with increased light levels was observed. (Author)

A82-11797 # A central tower solar test facility /RM/CTSTF/. S. Bevilacqua and R. Gislon (Comitato Nazionale per l'Energia Nucleare, Rome, Italy). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1742-1745. 9 refs.

The considered facility is intended for the conduction of test work in connection with studies of receivers, thermodynamic cycles, heliostats, components, and subassemblies. Major components of the test facility include a mirror field with a reflecting surface of 800 sq m, a 40 m tower, an electronic control system, a data-acquisition system, and a meteorological station. A preliminary experimental program is discussed, taking into account investigations related to facility characterization, an evaluation of advanced low-cost heliostats, materials and components tests, high-concentration photovoltaic experiments, and a study of advanced solar thermal cycles. G.R.

A82-11798 * # Secondary concentrators for parabolic dish solar thermal power systems. L. D. Jaffe and P. T. Poon (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1752-1758. 18 refs. Research sponsored by the U.S. Department of Energy and NASA.

A variety of different concepts are currently being studied with the objective to lower the cost of parabolic mirrors and to provide alternatives. One of the considered approaches involves the use of compound concentrators. A compound solar concentrator is a concentrator in which the sunlight is reflected or refracted more than once. It consists of a primary mirror or lens, whose aperture determines the amount of sunlight gathered, and a smaller secondary mirror or lens. Additional small optical elements may also be incorporated. The possibilities and problems regarding a use of compound concentrators in parabolic dish systems are discussed. Attention is given to concentrating secondary lenses, secondary imaging and concentrating mirrors, conical secondary mirrors, compound elliptic secondary concentrating mirrors, and hyperbolic trumpet secondary concentrating mirrors. G.R.

A82-11799 * # The effect of concentrator field layout on the EE 1 small community solar power system. R. L. Pons and R. E. Irwin (Ford Aerospace and Communications Corp., Aeronutronic Div., Newport Beach, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1759-1763. 6 refs. Contract No. JPL-955637.

The point-focusing distributed receiver (PFDR) concept is employed by a number of solar thermal power systems currently under development. One type of PFDR system which shows particular promise incorporates distributed energy generation. According to this concept each parabolic dish collector is a self-contained power generation module, and a conventional electrical system is used to interconnect the modules. The concept is thus modular, and any number of power modules can be combined to achieve the required plant size. Given the benefits of mass production, it appears that this type of system can produce electricity at lower cost than is projected for conventional (fossil) power systems over the next decade. An employment of organic Rankine cycle heat engines is considered. G.R.

A82-11800 * # Development of a solar receiver for an organic Rankine cycle engine. H. J. Haskins, R. M. Taylor, and D. B. Osborn (Ford Aerospace and Communications Corp., Aeronutronic Div., Newport Beach, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1764-1769. Contract No. JPL-955637.

A prototype power conversion assembly (PCA) developed by an American aerospace company is considered. The PCA will be mounted at the focal point of a 12 meter parabolic dish and will produce approximately 20 kW of 3 kHz ac power to a ground-mounted rectifier. The PCA includes a cavity receiver coupled to an organic Rankine cycle engine. The engine working fluid is toluene. The performance goals of the receiver design are to maximize both the thermal efficiency and the heat capacity of the core. The latter goal is desired for stabilizing the PCA operation during intermittent cloud cover. The receiver design is based upon the utilization of a direct-heated copper shell. It was necessary to develop a feasible manufacturing process for assuring a good braze joint between the stainless steel, containing the toluene, and the copper shell. G.R.

A82-11801 * # Control system development for a 1 MW/e/ solar thermal power plant. E. R. Daubert, F. M. Bergthold, Jr., and D. G. Fulton (Ford Aerospace and Communications Corp., Aeronutronic Div., Newport Beach, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1770-1775. Contract No. JPL-955115.

The point-focusing distributed receiver power plant considered consists of a number of power modules delivering power to a central collection point. Each power module contains a parabolic dish concentrator with a closed-cycle receiver/turbine/alternator assembly. Currently, a single-module prototype plant is under construction. The major control system tasks required are related to concentrator pointing control, receiver temperature control, and turbine speed control. Attention is given to operational control details, control hardware and software, and aspects of CRT output display. G.R.

A82-11802 # Dynamic performance analysis for the solar hybrid repowering of the El Paso Electric Company Newman Unit No. 1. D. A. Hofer and B. L. Pierce (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1776-1781. Contract No. DE-AC03-79SF-10740.

Newman Unit No. 1 has an 82 MWe tandem-compound, double-flow, reheat steam turbine. It was built in 1960 for baseload duty using natural gas as the primary fuel. The solar repowered configuration utilizes water/steam central receiver technology to provide main steam to the high pressure stage and reheat steam to the intermediate stage of the turbine-generator. Fossil energy is used to supplement solar generated steam for intermittent cloudy day operation and for economic dispatch when solar energy is not available. To aid in the feasibility study for the solar repowering of the unit, a digital simulation model was developed. The results obtained with the model indicate that the system is able to handle average velocity clouds with little degradation of the quality of electric power output. Approaches for improvements are also discussed. G.R.

A82-11803 # An evaluation of alternate system configurations for solar repowering electric power plants. L. E. Van Bibber and W. G. Parker (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1782-1786. Contract No. DE-AC03-79SF-10740.

The results of studies to determine the feasibility of using a solar tower power plant to repower an existing oil and gas fired electricity plant in El Paso, TX are presented. The existence of 3,500 acres of open land on site, lack of major environmental or legal constraints, increasing costs of conventional fuels, and the remaining economic life of an 82 MWe reheat steam turbine for which a pilot study could

effectively be made encouraged the study. One basic configuration was chosen and four others rejected. Heliostats with 57 sq m surfaces and a recirculative concept receiver tower were selected as items which would be commercially available in the near term; additional design considerations were concerned with several solar thermal/fossil fuel steam generator systems interfaces. The fossil fuel reheat boilers were considered as back-up for cloudy days, as storage showed no economic advantage. Economic projections indicate that production of standardized units would make the solar system economically competitive. M.S.K.

A82-11804 # Photovoltaic system studies and developments. D. G. Schueler (Sandia Laboratories, Albuquerque, NM). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2.
New York, American Society of Mechanical Engineers, 1981, p. 1832-1834. 17 refs. Research supported by the U.S. Department of Energy.

Photovoltaic technology has the potential of reducing dependence on conventional energy sources, if the cost of photovoltaic systems can be brought down in the range of $2 per peak Watt. The major potential applications for photovoltaic technology have been extensively analyzed with regard to their economics, market potential, and system performance requirements. These include residential, commercial and industrial, and utility central generation applications. This paper reviews the essential features of these various applications and outlines ongoing development activities. (Author)

A82-11830 # Utilization of wind/solar energy in generating electricity in Saudi Arabia. A. E. M. Nasser (Riyadh, University, Riyadh, Saudi Arabia). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2060-2063.

Solar and wind data averages gathered for five years and plans for a 1.2-1.4 kW solar wind energy plant at Riyadh, Saudi Arabia are presented. Wind speeds were gathered at 2 m height averaging 3.9 m/sec, and extrapolated to 22 m and 5.45 m/sec; average solar intensity was found to be 600 W/sq m between 6 a.m. and 6 p.m. The generator system comprises a 5.5 m diameter multiblade windpowered turbine on a 10 meter tower and photovoltaic modules generating 500 W. The NACA 0018 blade tips will be enclosed within a conical duct, augmenting the wind velocity by an expected 10%. Lead-acid batteries will be used for storage; initial applications of the system are targeted for remote villages and military outposts. M.S.K.

A82-11839 # Advanced Satellite Power System /SPS/ concept. W. V. McRae and G. M. Hanley (Rockwell International Corp., Space Operations and Satellite Systems Div., Seal Beach, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3.
New York, American Society of Mechanical Engineers, 1981, p. 2115-2118.

Evolution in design, improvements in economics, and reductions in material and space requirements for the Satellite Power System (SPS) are reviewed. Selection of GaAs solar cells over silicon wafers has been made for reasons of self-annealing and better performance at higher temperatures, in addition to the fact that GaAs cells are the base configuration for multibandgap cells. These cells, when used with 6:1 reflectors, reduce satellite mass by 18%, with a corresponding reduction in satellite area of 75%. The SPS can then be sun-oriented, eliminating tilt control; employment of magnetrons instead of less efficient klystrons eliminates 15% of transmitter weight. New evidence for ionospheric power density tolerance indicates higher permissible power levels, thus allowing larger and fewer (20 instead of 60) satellites delivering 7.57 GW per rectenna site, and capital costs are reduced 40%. Finally, open wire, parabolic rectennas will require 50% less in capital construction costs than former flat designs. The timetable for operational capability is now targeted for the year 2000. M.S.K.

A82-11842 # 'Thin foil cells - A challenge for space array designers'. P. A. Iles and F. Ho (Applied Solar Energy Corp., City of Industry, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2126-2128. 10 refs.

The present status of manufacturing, power output, and life expectancy of thin foil silicon cells (less than 50 micron thickness) is reviewed. Properties such as 14-15% efficiency, flexibility, light weight, radiation resistance, controllable absorptance, and area ranging from 4-25 sq cm are noted as favorable features, while the need for extra care in preparation, easy loss of a greater number of cells due to random cracking, and additional fabrication steps all add to costs. Lighter weight is a significant advantage in considerations for higher orbital placement, with present blanket thin cell packaging yielding from 50-330 W/lb. Further testing is necessary to show operational durability in thermal cycling and LEO radiation, and for radiation hardness against diffusion length degradation or resistivity changes in the semiconductor. Additional testing is also needed to verify successful deployment of the blanket arrays. Progress toward thinner cells (25 micron) with slightly less efficiency and toward dendritic web production are mentioned as showing promise for further cost reductions. M.S.K.

A82-11855 # Progress in large area photovoltaic devices based on amorphous silicon alloys. J. P. deNeufville, M. Izu, and S. R. Ovshinsky (Energy Conversion Devices, Inc., Troy, MI). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3.
New York, American Society of Mechanical Engineers, 1981, p. 2217-2220. 17 refs.

Photovoltaic cells using light absorbing thin amorphous films based on silicon appear to have properties suitable for the conversion of sunlight into electricity with a near-term efficiency in the range of 7-10% and at a cost in the range of 35-50 cents per peak watt. To meet these objectives, prototype 1-sq ft cells have been constructed and tested. The excellent yields obtained for such cells permitted the construction of a 24-sq ft array which produces useful power under exposure to both direct and diffuse natural illumination. Cost analyses and preliminary tests indicate that the deposition of electrodes and absorber in a continuous automated method of manufacturing will provide sufficient production throughput and device performance to meet the cost goals required for heat-to-head competition between a-Si alloy photovoltaics and conventional sources of electrical power in the U.S. (Author)

A82-11858 # A thermoelectric refrigerator powered by photovoltaic solar collectors. H. Sofrata. In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2239-2242. 5 refs.

A82-12269 # The effect of variable fluid properties on scale modeling. J. S. Kraabel (Sandia Laboratories, Livermore, CA). In: Momentum and heat transfer processes in recirculating flows; Proceedings of the Winter Annual Meeting, Chicago, IL, November 16-21, 1980. New York, American Society of Mechanical Engineers, 1980, p.103-110. 5 refs. Research supported by the U.S. Department of Energy.

The heat transfer to the air about a solar central receiver may be described as high Reynolds number (about 10,000,000), high Grashof number (about 10 to the 13th) mixed orthogonal convection. Although it is a low Mach number flow, it is highly compressible because of the large surface to free-stream temperature differences (500 to 1000 C). One approach to scale model testing that simultaneously achieves large values of Re and Gr in a mixed convection regime uses low temperature (80K) nitrogen. The present study examines the effects of temperature dependent variable fluid properties on stagnation line heat transfer. Although applicable only in the region of the stagnation line, and only for forced convection, the solution is suitable for this initial investigation because it is relatively easy to determine and because it may be used as the initial condition for the remainder of the flow. A comparison is made between solutions simulating scale model testing in low temperature nitrogen and solutions for ambient temperature air with wall temperatures equal to those of central receivers. The heat transfer coefficient described by Nu/square root of Re is found to be nearly constant for all circumstances studied. (Author)

A82-12501 **International Scientific Conference on Space, 21st, Rome, Italy, March 25, 26, 1981, Proceedings (Convegno Internazionale Scientifico sullo Spazio, 21st, Rome, Italy, March 25, 26, 1981, Atti).** Conference sponsored by the Ministero degli Affari Esteri, Ministero della Difesa, CNR, et al. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1981. 200 p. In Italian and English.

Papers are presented on solar power satellites and Spacelab technology. Topics covered include conversion and transmission techniques, safety problems, and structures and positioning in orbit. Attention is also given to cost considerations and energy balances for the SPS. Aspects of the first flight of Spacelab which were considered comprised scientific and technological experiments, material and life sciences, astronomy, plasma physics, and earth observations, experiment operation, and payload specialist training. M.S.K.

A82-12502 # **Market potential and problems for SSPS.** M. J. Claverie and A. P. Dupas (CNRS, Paris, France). In: International Scientific Conference on Space, 21st, Rome, Italy, March 25, 26, 1981, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1981, p. 17-25.

The paper examines the SSPS (satellite solar power station) as an energy system on a worldwide basis and assesses the possible limitations of the worldwide use of the SSPS. It is suggested that the SSPS is a very promising concept for the United States, but its use in many parts of the world may be severely hampered by its large power output and its large land requirements. Such a situation may jeopardize the international acceptance of the project. Thus, the study of alternative concepts allowing smaller receivers on the ground and smaller minimum power of the receivers seems advisable in order to reach an acceptable concept of a worldwide SSPS system. B.J.

A82-12506 # **Methods and problems of industrial-scale electric power generation from solar energy (Metodi e problemi per ricavare energia elettrica su scala industriale dalla solare).** P. L. Finocchi (Consorzio per Sistemi di Telecomunicazioni via Satelliti S.p.A., Milan, Italy). In: International Scientific Conference on Space, 21st, Rome, Italy, March 25, 26, 1981, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1981, p. 53-67. 10 refs. In Italian.

Ground-based and space-based methods of electric power generation from solar energy are considered, with attention given to both technical and economic factors. Two systems are discussed in particular: solar cells and thermoelectric generators; and attention is given to the technical and economic aspects of the construction and operation of satellite solar power stations. B.J.

A82-12507 # **Transportation systems and cost comparison for launching an SPS into geosynch. orbit.** D. E. Koelle (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). In: International Scientific Conference on Space, 21st, Rome, Italy, March 25, 26, 1981, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1981, p. 81-89. 6 refs.

Total mass requirements and costs are compared for Shuttle and orbital transfer as opposed to single vehicle to GEO and ballistic missiles plus orbital transfer to GEO for launch of an SPS. Noting that Shuttle delivery for one SPS would cost 5 billion dollars and require over 200 flights, three different ballistic missile delivery systems are analyzed. Use of a 500 megagram vehicle to LEO followed by orbital transfer to GEO is projected to be 3.6-4.8 billion dollars per SPS. A flyback capability is observed to be the most preferable solution, and calculations show that an equatorial launch can save 500-800 million dollars per SPS. Criteria for minimum costs are given as fully reusable system, unmanned vehicle, minimum stages, technical simplicity, operational simplicity, large size, minimal ground and orbital operations, and the equatorial launch site. M.S.K.

A82-12509 # **Solar power satellite system energy balance.** A. Buretti (Compagnia Nazionale Satelliti per Telecomunicazione S.p.A., Rome, Italy). In: International Scientific Conference on Space, 21st, Rome, Italy, March 25, 26, 1981, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1981, p. 99-103. 22 refs.

A literature review which concludes that the Shuttle is the basic launch system to LEO, in addition to an IUS, until the year 2000 is presented. Propellant to payload mass ratios are analyzed briefly to show that Shuttle launch can deliver only four tons to GEO, the prime site for the SPS. The energy requirements for propellant and solar array manufacture, and energy consumed in placing an SPS in GEO are calculated to be 5000 kWh/kg, while power delivered by an SPS is given as 700 kWh/kg. The results indicate that an improvement of one to two orders of magnitude is necessary for the SPS to satisfy the requirement that the energy it produces exceeds the power consumed in gaining operational status. M.S.K.

A82-12532 **Photovoltaics, the solar electric solution.** C. D. Beach and A. H. Litka (Florida Solar Energy Center, Cape Canaveral, FL). In: The year of the Shuttle; Proceedings of the Eighteenth Space Congress, Cocoa Beach, FL, April 29-May 1, 1981. Cocoa Beach, FL, Canaveral Council of Technical Societies, 1981, p. 3-36 to 3-41. 6 refs.

Direct conversion of solar energy to electricity by photovoltaic devices (solar cells) may be the most promising solution to the current energy problem. Photovoltaic energy systems provide a clean, simple method of energy conversion, and are reliable, safe, and flexible with respect to size (modular). The federal government is trying to commercialize photovoltaics by funding research on new materials and manufacturing processes. Earliest commercialization will be in residential systems, where the power grid back-up provides for a reliable electrical system without storage costs. The Florida Solar Energy Center has been operating a 5 kW experimental residential facility since 1980. The facility showed an average solar irradiance in the 62.5 sq m panels of 264 kw-hours/day from December 1980 through February 1981. The overall system efficiency was 7%, and the inverter operated with an ac output/dc input efficiency of 85-90%, depending on input levels. J.F.

A82-12812 **Theoretical analysis of the performance of a gravity-controlled solar concentrator.** L. Papa, G. A. Rottigni (Genova, Università, Genoa, Italy), and C. Caccherini. *Nuovo Cimento C, Serie 1*, vol. 4C, May-June 1981, p. 284-294. 5 refs. Research supported by the Consiglio Nazionale delle Ricerche.

Numerical calculations are presented of the performance of a solar concentrator with cylindrical parabolic symmetry, fixed focal axis, and a variable density reflector, the curvature of which is determined by gravity and the density distribution. The actual performance of the concentrator is deduced from measurements of total and diffuse solar radiation taken from 1964 to 1973 at Genoa, a city characterized by a typically maritime climate. The quantity of energy gathered by the solar collector is shown to be highly variable due to fluctuations in solar input, averaging 990 thermal kWh/sq m per year and in reasonable agreement with predictions based on a hypothesis of one clear day followed by one completely overcast day. Comparison of the geometrical concentration factors of purely gravity controlled solar concentrators with those of variable-density gravity controlled concentrators also demonstrates the advantages of the variable-density devices, which outweigh the supplementary costs associated with the provision for variable density by the suspension of chains under the reflecting surface. A.L.W.

A82-12817 **A numerical model of a graded band gap CdS/x/Te/1-x/ solar cell.** R. Redojcic, A. E. Hill, and M. J. Hampshire (Salford, University, Salford, England). *Solar Cells*, vol. 4, Sept. 1981, p. 109-120. 14 refs.

A numerical model of a graded bandgap CdS-CdTe solar cell is developed and used to optimize the design of an n-CdS(x)Te(1-x) - p-CdS(0.5)Te(0.5) thin film cell. The advantage of using a bandgap graded in the direction of thickness is the elimination of surface recombination losses by use of the window effect. The CdS-CdTe system was chosen because of the potential for thin film processing. The assumptions underlying the understanding of the CdS(x)Te(1-x) - CdS(0.5)Te(0.5) cell structure are given and a theoretical analysis is included. The photon flux is included as a function of photon energy by representing the solar spectrum as 100 discrete monoenergetic beams which are represented as numerical information in a computer. The energies are absorbed at some point within the graded bandgap layer, and an analytic description is furnished to describe

the distribution of photogenerated carriers in a graded layer. Thickness can be optimized by varying it proportionally with the bandgap; an optimal value of the base layer bandgap was found to be 1.35 eV. It is concluded that a graded bandgap device can be 1.8 times as efficient as a nongraded structure due to the lower reverse leakage current and greater fill factor in the graded device. M.S.K.

A82-12818 Preparation and properties of graded band gap CdS/x/Te/1-x/ thin film solar cells. R. Radojcic, A. E. Hill, and M. J. Hampshire (Salford, University, Salford, England). *Solar Cells*, vol. 4, Sept. 1981, p. 121-126. 9 refs.

The manufacture and experimental investigation of the properties of a thin film graded CdS(x)Te(1-x) solar cell are described. Graded CdS(x)Te(1-x) layers were vacuum co-deposited at a fixed rate of 20 A/sec by a shuttered method, in alternating layers of CdS and CdTe, to form an interdiffuse homogeneous CdS(x)Te(1-x) layer. Indium was added as a dopant to control the impurity concentration. Optical transmission of the films verified that the built-in field was stable, and a p-n barrier was found to exist. Photovoltages were measured to be 300 mV, but a SnO2 coating caused a resistance high enough to preclude measurement of the photocurrent. A combination of the window effect and a built-in field was observed, and the wide spectral response, particularly in the blue wavelengths, confirmed the theoretical predictions. Finally, copper was rejected as a contact electrode because of the tendency of its atoms to migrate along the grain boundaries and form trapping states and resistive paths. M.S.K.

A82-12819 Series resistance effects in 20 sq cm indium tin oxide-polycrystalline silicon solar cells. A. P. Genis, C. Osterwald, J. E. Mahan, and J. B. Dubow (Colorado State University, Fort Collins, CO). *Solar Cells*, vol. 4, Sept. 1981, p. 127-133. 17 refs.

Indium tin oxide-Si solar cells of 20.8 sq cm area and 9.2% total area efficiency were fabricated on polycrystalline substrates. The cell fabrication sequence is described, with particular attention to the formation of an adherent low resistance front-contact grid based on a solder-dipping process. A detailed series resistance analysis of the structure is given; the sheet resistance of the indium tin oxide layer is measured by a voltage-probing technique and is found to be the dominant series resistance component for the specific grid pattern used. (Author)

A82-12820 Effect of annealing CdS on a sintered CdS/Cu2S solar cell. K. Mukhopadhyay and H. Saha (Kalyani, University, Kalyani, India). *Solar Cells*, vol. 4, Sept. 1981, p. 135-146. 16 refs. Research supported by the Indian National Science Academy.

The effects of varying different parameters of formation on the performance and degradation of sintered CdS/Cu2S solar cells is described. CdS layers of 15 mm diameter and 0.8 mm thickness were formed after sintering at 800 C for 3 hr in an inert atmosphere, and then etching with HCl:H2O. Four equal pieces were cut with three sintered at 200 C, one in vacuum, one in argon, and one in air; the fourth was not annealed. The CdS layers were studied by scanning electron microscopy, and the resistivity and mobility by a perpendicular four-probe arrangement. Cells were formed and capacitance-voltage measurements taken at room temperature. Annealing in argon and air was found to decrease the resistivity and increase the mobility, whereas annealing in vacuum increased both the short-circuit current and open-circuit voltage, and increased the fill factor by a factor of about 1.74. Also, vacuum annealing decreased Cu diffusion to a minimum, leading to an almost complete elimination of degradation. M.S.K.

A82-12821 ZnO - p-InP heterojunction solar cells. K. P. Pande and C. N. Manikopoulos (Rutgers University, Piscataway, NJ). *Solar Cells*, vol. 4, Sept. 1981, p. 147-152. 9 refs.

The formation of ZnO-p-InP heterojunctions by means of a reactive evaporation technique for the deposition of ZnO is reported. ZnO is highly regarded as a window layer because of its low sheet resistivity, high transparency, and large energy gap (3.2 eV). The p-InP fabrication is described, and the Zn layer was formed by pumping the chamber pressure down to one-millionth torr, bleeding in oxygen at 10 mtorr, evaporating Zn in a crucible by resistive heating, and activating a glow discharge to form a ZnO layer on the InP substrate. Annealing took place at 250 C for 2 min in an argon atmosphere, yielding a ZnO layer with a conductivity of 72 ohm/cm and more than 85% transparency. I-V curves are plotted, capacitance-voltage data are reported, and photovoltaic properties are graphed and discussed, noting that recombination centers are expected to be eliminated with further optimization of the ZnO layer. The cells had a 6.6% efficiency and series resistance of 30 ohms. M.S.K.

A82-12822 Photoelectrochemical behaviour of CdS/NaI.3.3NH3 /liquid sodium iodide ammoniate/ junctions - Utilization in solar energy conversion. D. Guyomard, M. Herlem (Paris, Ecole Supérieure de Physique et de Chimie Industrielles, Paris, France), R. Heindl (CNRS, Laboratoire d'Etude des Matériaux par des Techniques Avancées, Meudon, Hauts-de-Seine, France), and J.-L. Sculfort (CNRS, Laboratoire d'Electrochimie Interfaciale, Meudon, Hauts-de-Seine, France). *Solar Cells*, vol. 4, Sept. 1981, p. 157-167. 26 refs. Direction des Recherches, Etudes et Techniques Contract No. 79-1210.

A liquid NaI.3.3NH3 solution was used as the medium in a photoelectrochemical cell to stabilize the working of CdS photoanodes and results are reported. The reference voltage of in situ Ag-Ag(plus) electrodes in the NaI.3.3NH3 solution is 0.27 V. The CdS samples were polished with diamond paste, rinsed in distilled water, and etched with HCl; ohmic contacts were formed on the backs with an evaporated gold and indium coating. Cyclic voltammetry was used to measure the electroactivity range, and a depletion layer was determined to exist in the space charge layer when an anodic current was found with reverse bias. High sensitivity to daylight was found, and this is attributed to the etching treatment and reactions to bulk energy levels. The addition of iodine to the solution was found to stabilize the photocurrent with a simultaneous rise in acidity; the iodine eventually vanishes unless the NH4(plus) is above 0.5 M or when the pH is near zero. An overall efficiency of 2 percent is noted, and the stabilization due to iodine presence resulted in cell operation for over a month. M.S.K.

A82-12823 A practical method of analysis of the current-voltage characteristics of solar cells. J. P. Charles (Tunis, Ecole Nationale d'Ingénieurs, Tunis, Tunisia), M. Abdelkrim, Y. H. Muoy (Faculté des Sciences, Tunis, Tunisia), and P. Mialhe (Ecole Normale Supérieure, Dakar, Senegal). *Solar Cells*, vol. 4, Sept. 1981, p. 169-178. 15 refs.

A numerical method suitable for use with a programmable calculator is developed for determining the current-voltage (I-V) equation parameters of a solar cell driven as a generator only. The exact magnitude of the photocurrent is found and the fill factor is deduced. High and low quality Si solar cells were studied under illumination from a 12 V lamp in AM1 conditions. I-V curves are plotted for varying diode quality factors and the fill factors were analytically examined. Series resistance, shunt resistance, photocurrent, series current, and diode quality factors were calculated from the experimental data of the fourth quadrant characteristic for an ideal cell and results are diagrammed with performance data from the test cells. A flow chart is provided for the operations of the program. The quality factor is found to be dominant, unless significant output losses are encountered, and then series and shunt resistances gain effect. M.S.K.

A82-12824 V2O5-Si photovoltaic cells. J. Gobrecht, R. Nottenburg, K. Chewey, and S. Wagner (Solar Energy Research Institute, Golden, CO). *Solar Cells*, vol. 4, Sept. 1981, p. 179-186. 13 refs.

The results of experimentation of the preparation of V2O5 films for solar cells is presented. The V2O5 films were prepared in three ways: (1) a powder was annealed directly on a Si wafer; (2) 0.02 M solutions of V2O5 in 5N HCl were applied directly with a dropper; and (3) the solution was misted on substrates heated to about 200 C. I-V characteristics, film resistivities, and C-V measurements were made under AM1 conditions, and the use of a forming gas was found to decrease the sheet resistivity. Evidence was found for an interfacial barrier and Auger electron spectroscopy indicated the presence of a silicon rich oxide layer, but the thickness was not determined. A reaction of V2O5 with Si was demonstrated at different formation temperatures. Adding a dopant such as H2 annealing at 600 C lowered the interface resistance from 1 k-ohm/cm to 2 ohm/cm; however, increasing the barrier conductance did not

increase either the short circuit current or open circuit voltage, factors which yet preclude practical use of the V2O5-Si cell. M.S.K.

A82-12825 Temperature dependence of the short-circuit current in MIS solar cells. S. K. Krawczyk, A. Jakubowski, and M. Zurawska (Warszawa, Politechnika, Warsaw, Poland). *Solar Cells*, vol. 4, Sept. 1981, p. 187-194. 14 refs.

A theoretical study of the temperature dependence of the short-circuit current (Isc) in MIS solar cells, particularly Al-SiO2 - p-Si, is presented. A current flow model is developed, assuming a small potential drop across the dielectric layer, no fast surface states at the Si-SiO2 interface, and device thickness much larger than the minority carrier diffusion length. Negligible series resistance and shunt conductance, and no temperature dependence by either the energy gaps in Si or SiO2, or the minority carrier lifetime, or the absorption coefficient were also assumed. The behavior of Isc as a function of temperature is explained by a displacement of the quasi-Fermi levels at the semiconductor surface, and changes in Isc are caused by increase in the recombination and diffusion currents with increasing temperature. Fabrication procedures for the MIS cells are provided. It is noted that the effective dielectric thickness is different from the measured dielectric thickness, and further work is indicated to determine the effect of oxidation conditions on this thickness. M.S.K.

A82-12949 High-temperature solar central receivers. A. C. Skinrood (Sandia National Laboratory, Livermore, CA). *Sunworld*, vol. 5, July 1981, p. 97-104.

Designs and concepts for solar central receiver thermal power plants are reviewed. Concentrations of over 1,000 suns are now possible, and seven prototype plants, producing from 1-10 MWe, are close to completion, employing cavity and external receiver configurations. Heat transfer fluids are discussed, noting that the water/steam cycle is emerging as the dominant mode; liquid sodium is benefitting from extensive testing for nuclear power plants; molten salt provides thermal storage at $10-30/kWt-hr; high temperature gas systems (815 C) can be applied for gypsum board drying and NH3 production. Heliostats are all of a steel/glass configuration and require mass production to become economical. Thermal storage systems, applications for repowering in conjunction with conventional power plants, and cogeneration for electricity/process heat are examined, and power costs are projected to match those of coal if the central receiver construction costs can be halved. D.H.K.

A82-12960 Solar perspectives - Israel, solar pond innovator. S. Winsberg. *Sunworld*, vol. 5, July 1981, p. 122-125.

Existing and planned solar pond electricity producing power plants in Israel and California are discussed. Salt ponds, with salinity increasing with depth, are coupled with low temperature, organic working fluid Rankine cycle engines to form self-storage, nonpolluting, electric plants. Average pond thermal gradients range from 25 C surface to 90 C at the bottom; 160 GW of potential power have been projected as current available from existing natural solar ponds from a partial survey of 14 countries. The largest installation to date has a 220 kW output, and a 5 MW plant is scheduled for completion in 1983. Efficiencies of 10% and a cost of $2,000/kW for a 40 MW plant are projected, a cost which is comparable to that of conventional plants. The 40 MW plant is an optimized design, allowing for modular plant additions to increase capacity. D.H.K.

A82-13083 The effect of non-Markovian cloud patterns on the design of a regulator for a solar-powered boiler. D. D. Sworder (California, University, La Jolla, CA) and K. L. Zondervan (Aerospace Corp., Guidance and Control Div., El Segundo, CA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1. New York, American Institute of Chemical Engineers, 1981. 2 p. (WA-3F). NSF Grant No. ECS-80-80-03647; Contract No. DE-AC03-78ET-20517.

This paper provides the regulator synthesis equations for the steam temperature regulator in a solar-powered boiler. The primary source of disturbance is produced by the motion of clouds across the field of mirrors which focus solar energy on the boilers. To permit flexibility in describing a variety of cloud conditions, the cloud model is non-Markov. (Author)

A82-13199 Oxide optimization at the p-Si/aqueous electrolyte interface. H. J. Lewerenz, M. Lübke (Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Fritz-Haber-Institut, Berlin, West Germany), K. J. Bachmann (North Carolina State University, Raleigh, NC), and S. Menezes (Bell Telephone Laboratories, Inc., Murray Hill, NJ). *Applied Physics Letters*, vol. 39, Nov. 15, 1981, p. 798-800. 22 refs.

A combination of surface chemical and voltammetric treatments have been used to optimize the stability and performance of p-Si/v(2+)-v(3+)4MHCl/C solar cells. B-doped Si electrodes exposing a (100) face to the electrolyte, a spectroscopically pure C counter-electrode and a saturated calomel electrode were used in a 3-electrode potentiostatic arrangement. A power conversion efficiency of 6.1% under 80-mW/cm sq illumination was recorded. S.C.S.

A82-13200 Thin-film gallium arsenide homojunction solar cells. S. S. Chu, T. L. Chu, F. S. Zhang, L. Book, and J. M. Yu (Southern Methodist University, Dallas, TX). *Applied Physics Letters*, vol. 39, Nov. 15, 1981, p. 803-805. 5 refs. Contract No. X50-9002-3.

Thin film homojunction GaAs solar cells of p(+)/n/n(+) configuration were deposited on tungsten-coated graphic substrates by the reaction of gallium, hydrogen chloride, and arsine containing approriate dopants. Solar cells with an area of 8 cm sq and an AM1 efficiency of about 7% were produced. The observed low fill factor is caused by grain boundary shunting and high series resistance. The cells are characterized by dark and illuminated current voltage and quantum efficiency measurements. S.C.S.

A82-13284 Chromatic aberration effect on solar energy systems using Fresnel lenses. E. Lorenzo (Madrid, Universidad Politécnica, Madrid, Spain). *Applied Optics*, vol. 20, Nov. 1, 1981, p. 3729-3732. 12 refs.

A82-13285 Luminescent solar concentrators. II - Experimental and theoretical analysis of their possible efficiencies. J. S. Batchelder, T. Cole (California Institute of Technology, Pasadena, CA), and A. H. Zewail. *Applied Optics*, vol. 20, Nov. 1, 1981, p. 3733-3754. 12 refs. Research supported by the U.S. Department of Energy and ARCO Solar, Inc.

Experimental techniques are developed to determine the applicability of a particular luminescing center for use in a luminescent solar concentrator (LSC). The relevant steady-state characteristics of eighteen common organic laser dyes are given. The relative spectral homogeneity of such dyes are shown to depend upon the surrounding material using narrowband laser excitation. Three independent techniques for measuring self-absorption rates were developed; these are time-resolved emission, steady-state polarization anisotropy, and spectral convolution. Preliminary dye degradation and prototype efficiency measurements are included. Finally, simple relationships are given relating the efficiency and gain of an LSC to key spectroscopic parameters of its constituents. (Author)

A82-13713 † Investigation of the possibility of using inexpensive concentrating systems in the modules of a photoelectric station (K issledovaniiu vozmozhnosti ispol'zovaniia deshevykh kontsentriruiushchikh sistem v moduliakh fotoelektricheskoi stantsii). F. A. Akhmedov, Sh. Z. Mirtursunov, and R. A. Muminov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 4, 1981, p. 10-13. In Russian.

The use of various types of inexpensive concentrators in a solar power station with GaAs-Al(x)Ga(1-x)As cells and single-axis sun tracking is discussed. An analysis is presented of the dependence of the total efficiency of a module on the level of concentration, and of the distribution of radiation intensity in the focal plane for various types of concentration. B.J.

A82-13715 † Analysis of the optical characteristics of solar collectors (Analiz opticheskikh kharakteristik solnechnogo kollektora). O. S. Popel', S. E. Frid, and E. E. Shpil'rain (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). *Geliotekhnika*, no. 4, 1981, p. 27-32. 5 refs. In Russian.

The influence of the optical characteristics of a collector on its efficiency is investigated. It is shown that the optical thickness of the transparent coating has the determining influence on the maximum

efficiency of the collector. The effects of solar-radiation incidence angle, dust contamination, and shadowing on the efficiency of the collector are also examined. B.J.

A82-13716 † Production and certain properties of photoelectric cells based on silicon epitaxial structures (Poluchenie i nekotorye svoistva fotoelektricheskikh preobrazovatelei na osnove epitaksial'nykh struktur kremniia). M. S. Saidov, B. M. Abdurakhmanov, R. Aliev, and V. P. Chirva (Akademiia Nauk Uzbekskoi SSR, Institut Elektroniki, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 4, 1981, p. 33-38. 8 refs. In Russian.

The feasibility of using silicon epitaxial structures of p(+)-n, n(+)-p, and p-p(+) types as photoelectric-cell materials is evaluated. The basic characteristics of such cells are investigated, including volt-ampere, load, and spectral characteristics, and the dependence of these characteristics on temperature and illumination intensity. It is concluded that such epitaxial structures can be successfully used as solar-cell materials. B.J.

A82-13717 † System of tolerances for a solar-tower power station (Sistema dopuskov dlia SES bashennogo tipa). R. R. Aparisi and D. I. Tepliakov (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *Geliotekhnika*, no. 4, 1981, p. 39-44. 8 refs. In Russian.

The principles underlying the establishment of a system of tolerances for a solar-tower station are presented. Attention is given to static and dynamic tolerances and deviations for a single heliostat, and geometrical tolerances for a field of heliostats. B.J.

A82-13718 † Mathematical simulation model for the operation of the optical system of a solar power station (Matematicheskaia imitatsionnaia model' raboty opticheskoi sistemy SES). I. V. Baum (Akademiia Nauk Turkmenskoi SSR, Institut Ispol'zovaniia Solnechnoi Energii, Turkmen SSR). *Geliotekhnika*, no. 4, 1981, p. 45-52. In Russian.

A82-13737 Amorphous silicon bibliography - Introduction. A. H. Mahan and J. L. Stone (Solar Energy Research Institute, Golden, CO). *Solar Cells*, vol. 4, Oct. 1981, p. 205, 207-267, 269-291 (50 ff.). 1964 refs.

A bibliography of works about amorphous silicon is presented. It includes works published during the 1977-1980 period. Among the topics covered in the papers are: (1) photoelectrochemistry of hydrogenated amorphous silicon; (2) laser annealing of hydrogenated amorphous silicon; (3) electronic hopping transport in disordered materials; (4) tunneling in hydrogenated amorphous silicon; and (5) the frequency-dependent dielectric behavior of amorphous silicon thin films. S.C.S.

A82-13803 A new low temperature III-V multilayer growth technique - Vacuum metalorganic chemical vapor deposition. L. M. Fraas (Chevron Research Co., Richmond, CA). *Journal of Applied Physics*, vol. 52, Nov. 1981, p. 6939-6943. 11 refs.

A new technique for multilayer growth by metalorganic chemical vapor deposition is described. The vacuum metalorganic chemical vapor deposition technique combines the low-temperature growth capability of molecular beam epitaxy with the source handling system of chemical vapor deposition. The viability of the new technique is demonstrated by the growth of high-mobility layers of GaAs, GaAs(1-x)P(x), and Ga(1-x)In(x)As at 570 C. Room-temperature mobilities of GaAs films as high as 4990 sq cm/V s are obtained. Doping of both p-type and n-type films is demonstrated. GaAs shallow homojunction solar cells fabricated with this technique are described. Active-area solar cell efficiencies as high as 19.6% are obtained with 6 'suns' AM2 concentrated light. This multilayer growth technique is particulary suited to the fabrication of multicolor solar cells. (Author)

A82-13804 Dependence of minority carrier diffusion length on illumination level and temperature in single crystal and polycrystalline Si solar cells. P. C. Mathur, R. P. Sharma, P. Saxena (Delhi, University, Delhi, India), and J. D. Arora (Delhi, University, Delhi; Hindu College, Moradabad, India). *Journal of Applied Physics*, vol. 52, Nov. 1981, p. 6949-6953. 29 refs.

A82-13805 Investigation of the performance of an MoS2/I-/I2/C electrochemical solar cell. R. Audas and J. C. Irwin (Simon Fraser University, Burnaby, British Columbia, Canada). *Journal of Applied Physics*, vol. 52, Nov. 1981, p. 6954-6960. 19 refs. Research supported by the British Columbia Science Council.

The performance of an electrochemical solar cell with a single crystal of MoS2 in an I(-)/I2 electrolyte has been investigated. An efficiency greater than 5% has been obtained by carefully cleaving the crystal to ensure a good quality surface, and by optimizing the electrolyte concentration. The cell performance has been compared to the predictions of a phenomenological model that incorporates a term representing a diffusion overvoltage. Excellent agreement with the experimental results has been obtained with two free parameters, representing the shunt and series resistance of the cell. (Author)

A82-13806 Low frequency capacitance characterizations on indium/x-phase of metal free phthalocyanine solar cells. Y. H. Shing and R. O. Loutfy (Xerox Research Center of Canada, Mississauga, Ontario, Canada). *Journal of Applied Physics*, vol. 52, Nov. 1981, p. 6961-6964. 11 refs. Research supported by the National Research Council of Canada.

A82-14001 * // Dish concentrators for solar thermal energy - Status and technology development. L. D. Jaffe (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2530*. 11 p. 8 refs.

Comparisons are presented of point-focusing, or 'dish' solar concentrator system features, development status, and performance levels demonstrated to date. In addition to the requirements of good optical efficiency and high geometric concentration ratios, the most important future consideration in solar thermal energy dish concentrator design will be the reduction of installed and lifetime costs, as well as the materials and labor costs of production. It is determined that technology development initiatives are needed in such areas as optical materials, design wind speeds and wind loads, structural configuration and materials resistance to prolonged exposure, and the maintenance of optical surfaces. The testing of complete concentrator systems, with energy-converting receivers and controls, is also necessary. Both reflector and Fresnel lens concentrator systems are considered. O.C.

A82-14002 * // Buffer thermal energy storage for a solar Brayton engine. H. J. Strumpf and K. P. Barr (AiResearch Manufacturing Company of California, Torrance, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2531*. 10 p. Contracts No. NAS7-100; No. JPL-955136.

A study has been completed on the application of latent-heat buffer thermal energy storage to a point-focusing solar receiver equipped with an air Brayton engine. To aid in the study, a computer program was written for complete transient/stead-state Brayton cycle performance. The results indicated that thermal storage can afford a significant decrease in the number of engine shutdowns as compared to operating without thermal storage. However, the number of shutdowns does not continuously decrease as the storage material weight increases. In fact, there appears to be an optimum weight for minimizing the number of shutdowns. (Author)

A82-14003 * // Development, solar test, and evaluation of a high-temperature air receiver for point-focusing parabolic dish applications. E. J. Hanseth (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2532*. 8 p. 5 refs.

A high temperature solar receiver was fabricated and tested in excess of 1370 C on an 11-meter-diameter test bed concentrator at the Jet Propulsion Laboratory Parabolic Dish Test Site, Edwards, California. The 60-kilowatt thermal receiver design utilizes state-of-the-art silicon carbide honeycomb matrix panels to receive and transfer the solar energy and mullite elements for thermal buffer storage. Solar tests were conducted with indicated air exit temperatures ranging from 885 C (1625 F) to 1427 C (2600 F), mass flow rates of 75 to 105 g/sec (0.16 to 0.23 lbm/sec), and pressures up to

265 kPa absolute (38.4 psia). Estimates of efficiency are 59.7% at 1120 C (2048 F) to 80.6% at 885 C (1625 F) when aperture spillage losses are considered separately. Results are presented which demonstrate the feasibility of this innovative receiver concept for point-focusing parabolic dish applications over a wide temperature range. (Author)

A82-14004 # **Feasibility of solar assisted ethanol production.** M. L. Holden, A. N. Shekar, and T. F. Smith (Iowa, University, Iowa City, IA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2533.* 9 p. 15 refs. Research supported by the Iowa Energy Policy Council and U.S. Department of Energy.

Interest in alternative liquid fuels is growing due to the increasing scarcity and cost of conventional fuels. One such alternative is ethanol fuel. A positive energy balance associated with production of ethanol fuel, however, has been a point of concern. Utilizing 'free' solar process energy can displace non-renewable fuels and produce a more favorable energy balance. The purpose of this study is to ascertain the feasibility of a solar assisted ethanol fuel production system utilizing a simulation model. System sensitivity to collector area, configuration, and type along with ethanol fuel production rate, distillation pressure and temperature, and thermal energy storage size are examined. (Author)

A82-14005 * # **Solar concentrator panel and gore testing in the JPL 25-foot space simulator.** E. W. Dennison and M. J. Argoud (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2534.* 7 p.

The optical imaging characteristics of parabolic solar concentrator panels (or gores) have been measured using the optical beam of the JPL 25-foot space simulator. The simulator optical beam has been characterized, and the virtual source position and size have been determined. These data were used to define the optical test geometry. The point source image size and focal length have been determined for several panels. A flux distribution of a typical solar concentrator has been estimated from these data. Aperture photographs of the panels were used to determine the magnitude and characteristics of the reflecting surface errors. This measurement technique has proven to be highly successful at determining the optical characteristics of solar concentrator panels. (Author)

A82-14013 # **Solar thermal cost goals - Implementing a methodology for assessing break-even value and market potential.** W. E. Fraize and J. Gordon (Mitre Corp., McLean, VA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2550.* 10 p. 5 refs. Contract No. DE-AC01-79ET-21047.

Cost goals for solar thermal technologies are being reviewed and updated by the U.S. Department of Energy. This paper describes a methodology for determining cost goals for electric utility and industrial applications. The methodology consists of: (1) estimating break-even capital or delivered energy cost to the users; (2) incorporating the economic and financial analysis that may be employed by the potential user; and (3) relating break-even costs to potential market size as a basis for setting cost goals. The approach to cost goals presented here is not technology dependent. As a result, it can be applied to any emerging technology and can be used to develop consistent cost targets across a number of diverse technologies. (Author)

A82-14014 # **A method for preliminary evaluation and sizing of solar thermal cogeneration system applications.** J. T. Ator (Aerospace Corp., Energy and Resources Div., El Segundo, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2551.* 14 p. 20 refs.

A simplified system model has been found helpful in evaluating proposed solar cogeneration applications. The necessary data base includes mean daily insolation and average daily loads for each month. A combination of direct and stored solar thermal energy, purchased power, and heat energy derived from organic fuels is included in the modeling to ensure 24-hour effectiveness in meeting all thermal and electrical loads. The effect of varying collector field size on total annual displacement of fossil energy is determined without the complexity of hour-by-hour simulation. An application to a hypothetical large military base is presented to illustrate the method. (Author)

A82-14015 * # **Use of ceramics in point-focus solar receivers.** R. H. Smoak and A. A. Kudirka (California Institute of Technology, Jet Propulsion Laboratory, Applied Mechanics Div., Pasadena, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2552.* 10 p. 15 refs. Research sponsored by the U.S. Department of Energy and NASA.

One of the research and development efforts in the Solar Thermal Energy Systems Project at the Jet Propulsion Laboratory has been focused on application of ceramic components for advanced point-focus solar receivers. The impetus for this effort is a need for high efficiency, low cost solar receivers which operate in a temperature regime where use of metal components is impractical. The current status of the work on evaluation of ceramic components at JPL and elsewhere is outlined and areas where lack of knowledge is currently slowing application of ceramics are discussed. Future developments of ceramic processing technology and reliability assurance methodology should open up applications for the point-focus solar concentrator system in fuels and chemicals production, in thermochemical energy transport and storage, in detoxification of hazardous materials and in high temperature process heat as well as for electric power generation. (Author)

A82-14405 **A simplified method for direct calculation of the annual load fraction of solar systems for space heating.** M. M. Hawas and M. R. Abou-Zeid (Garyounis, University, Benghazi, Libya). *Energy* (UK), vol. 6, Sept. 1981, p. 933-943. 11 refs.

A82-14406 **Thermal analysis of three zone solar pond.** M. S. Sodha, N. D. Kaushik, and S. K. Rao (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research*, vol. 5, Oct.-Dec. 1981, p. 321-340. 20 refs.

A periodic analysis of a three zone solar pond as a solar collector and a heat storage medium is presented. The pond is modelled as having an upper convective zone, a middle nonconvective layer, and a lower convective zone. The walls are insulated, and the bottom is blackened, and salt concentrates in the middle zone, with increasing density downwards. Solar short wave radiation passes through to the bottom and is absorbed, while IR rays penetrate only a few cm. Six harmonics are used as a representation of the periodic variation of atmospheric temperature and solar intensity. The Fourier heat conduction equation for the nonconvective region is solved explicitly, and the convective heat and mass flux through the pond is accounted for. Reflective losses and radiation attenuation with depth are approximated by use of an effective extinction coefficient. Numerical results are obtained which indicate an increase of efficiency with temperature, leveling off at 5% at a collection temperature of 90 C. M.S.K.

A82-14445 **Contributions of space reflector technology to food production, local weather manipulation and energy supply, 1995-2020.** K. A. Ehricke (Space Global Co., La Jolla, CA). *British Interplanetary Society, Journal (Space Technology)*, vol. 34, Dec. 1981, p. 511-518.

The parameters and uses of orbital space reflectors to redirect measured amounts of solar radiation to selected areas of the earth are discussed. Two systems, Lunetta - night illumination, and Soletta - solar level irradiation, are considered, noting that solar level reflectance is over a thousand times brighter than moonlight. Optimized orbits, reflective angles, and mirrored surfaces are explored for controlling the image size and location. Soletta applications are envisioned for weather modification, as a source of night time power for electrical generation, and to enhance biomass growth; Lunetta reflectors may be used for urban, polar, and rural illumination, and as a light source for disaster and rescue operations. A prototype Lunetta would have a 1,860 sq km area, with full scale models ranging from 18 to 50 times larger. D.H.K.

A82-14446 A technological approach towards future large solar arrays. B. Goergens (Space and New Technologies, Wedel, West Germany). *British Interplanetary Society, Journal (Space Technology)*, vol. 34, Dec. 1981, p. 519-526. 5 refs.

Developmental strategies for large solar arrays for future space missions are described, noting that enlargements for the near term will be dependent on the ability to interface with the Shuttle. Spacelab missions, currently scheduled for seven days duration, could be extended to 30-90 days if power was available. Higher cell efficiencies, deployable blanket technology, space based mass production of solar cells, and capabilities to handle high voltages are listed as priorities for solar cell development. A comparison is made between technologies for solar and terrestrial solar cells, and mention is made of 100 micron thick cells, 5 x 5 sq cm cells, back field cells, and back reflective surface cells for space applications. A 50 kW array with foldable deployment, high voltage technology, and the success of welded cells are outlined. D.H.K.

A82-14667 Gallium-arsenic-antimony heterojunction photocells. V. M. Andreev, N. S. Zimogorova, O. O. Ivent'eva, V. I. Myrzin, and S. P. Troshkov. *(Pis'me v Zhurnal Tekhnicheskoi Fiziki*, vol. 7, Feb. 12, 1981, p. 132-135.) *Soviet Technical Physics Letters*, vol. 7, Feb. 1981, p. 56, 57. 8 refs. Translation.

A study of heterojunction solar cells with a narrow-gap GaAs(1-x)Sb(x) layer and a wide-gap GaAs window is reported. Photocurrent spectra of these heterojunction structures is presented. The attainment of reverse breakdown voltages of 25-30 V in the diodes shows that it is possible to produce structures in which the lattice mismatch of the substrate and the narrow-gap layer will have a minimal effect on the properties of the p-n junction. B.J.

A82-14846 # Optimization of flow passage geometry for air-heating, plate-type solar collectors. K. G. T. Hollands and E. C. Shewen (Waterloo, University, Waterloo, Ontario, Canada). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Nov. 1981, p. 323-330. 11 refs. National Research Council of Canada Contract No. 125Q31155-7-4409.

Rectangular and triangular duct air flow solar collectors are analyzed to determine the optimum configuration for the flow passages. The pressure drop and mass flow rates are assumed to be specified values, and a uniform heat flux boundary condition is used to define the upper surface. A model for heat transfer in a flow in an infinite passage is considered, and it is shown that once the channel length is chosen, all other terms become fixed. The forced convective heat transfer is found to depend on the length of the channel in the collector. A design for a short-path collector is presented, where manifolds constrain air flow to half of the collector width in any one passage, and a lower limit to passage width is obtained as 2 mm. The V-groove collector offers higher efficiencies than the flat plate-type by 7-12% m and the optimal flow length is found at 0.5 m minimum. D.H.K.

A82-14847 # Material property data and their use in design and analysis for an elevated temperature solar code. I. Berman (Foster Wheeler Development Corp., Livingston, NJ). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Nov. 1981, p. 345-350. 20 refs.

Specific properties of the materials, temperatures, and operating parameters for elevated temperature solar thermal power plants are considered as a basis for developing standards of implementation. Physical and mechanical properties such as thermal conductivity, elastic modulus, expansion, strength, and creep are discussed and recommendations for ASME Code I and III materials are cited where feasible. Inelastic behavior tests involving beam bending, pipe ratcheting, torsion-torsion tests, and axial cyclic tests of various stainless steel specimens and Incoloy 800 material are reported. Peculiarities of problems for solar applications are noted to be a lack of information of basic material behavior due to the low amount of actual operational experience, a large number of transient temperature cycles, and primary creep. D.H.K.

A82-15006 # Silicon and gallium arsenide photovoltaic cells - Models for the functioning, experimentation, and application to concentrating collectors (Les cellules photovoltaiques au silicium et à l'arseniure de gallium - Modèles de fonctionnement, experimentation et application aux générateurs sous concentration). F. Therez. Toulouse III, Université, Docteur d' Etat Thesis, 1980. 198 p. 68 refs. In French.

Theoretical and experimental studies are reported for the use of Si and GaAs monocrystalline solar cells in concentrator configurations. Behavior of the cells' structures are examined, and homojunction (HJ) and heterojunction (HTJ) cells are explored for the effects on the electrical properties caused by larger sizing. Analytical models are developed to show that diffusion and conduction are the pertinent mechanisms for current-voltage characteristics of HJ and HTJ cells, and concepts of Auger recombination and reduction of the width of the forbidden band are introduced. A numerical model is presented for optimization of nonconcentrating systems, and a two-dimensional study is made of concentrating systems to establish a design for the cover of the concentrator. Finally, bicolor cells involving the bonding of Si and GaAs cells are considered, with efficiencies provided based on relations to monolithic and multispectral cells. M.S.K.

A82-15111 Sputtered thin film electrodes for photoelectrochemical cells. A. A. Soliman and H. J. J. Seguin (Alberta, University, Edmonton, Canada). *Canadian Journal of Physics*, vol. 59, Nov. 1981, p. 1674-1679. 14 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada and Imperial Oil Corp.

Semiconducting TiO2 film photoelectrodes were prepared by dc sputtering from a simple hot pressed TiO2 powder target. To make the target semiconducting, it was first heated in a hydrogen atmosphere. Films so produced on heated glass substrates were polycrystalline and strongly adhered to the substrates. When tested for photoelectrolysis, these films were chemically stable and did not exhibit any photodecomposition. The spectral response was investigated and a main absorption edge at about 400 nm was obtained. The technique appears attractive for inexpensive large scale production of photoelectrodes for solar-hydrogen conversion. (Author)

A82-15112 Current-voltage characteristics of semiconductor-electrolyte junction solar cells. F. El Guibaly and K. Colbow (Simon Fraser University, Vancouver, Canada). *Canadian Journal of Physics*, vol. 59, Nov. 1981, p. 1682-1685. 15 refs.

An improved model for the semiconductor-electrolyte solar cell is discussed. Charge transfer kinetics, surface recombination, recombination in the quasi neutral region and in the depletion region, as well as the series and shunt resistance of the cell are included in the model. It is shown that the surface transfer velocity of minority carriers across the semiconductor-electrolyte interface affects primarily the open circuit voltage, the fill factor and power conversion efficiency, and only to a lesser degree the short circuit current. As is the case with nonelectrolyte solid state cells, the series resistance of the electrochemical cell reduces the fill factor and the conversion efficiency, while the shunt resistance reduces the open circuit voltage of the cell in addition to reducing the fill factor and the power conversion efficiency. (Author)

A82-15439 Colloidally deposited high-temperature solar selective surfaces. J. J. Zybert and D. R. McKenzie (Sydney, University, Sydney, Australia). *Applied Optics*, vol. 20, Dec. 1, 1981, p. 4051-4053. 11 refs.

Thin, colloidally deposited coatings with uniform thickness for solar selective surfaces are described. A 200 nm Cu film was deposited on glass by vacuum evaporation in an electron beam coating chamber. A second layer of colloidally suspended Si and C was deposited by slowly withdrawing the copper-coated substrate from the colloidal dispersion; uniform thicknesses of 200 and 480 nm were obtained. Reflectance was in the 1-1.5 micron region and emittance (highest for thickest coatings) levelled off after baking at 400 C. The film withstood 600 C temperatures for 200 with no loss in absorptance, compared to a 2% loss after 500 C for 100 hr for both vacuum evaporated cermets and sputter deposited titanium silicide coatings. Further improvements are predicted by the use of colloids with higher volume fractions of silica and lower concentrations of carbon. M.S.K.

A82-15441 An analytical model for high-low-emitter /HLE/ solar cells in concentrated sunlight. W.-Z. Shen and C.-Y. Wu (National Chiao Tung University, Hsinchu, Republic of China).

Solid-State Electronics, vol. 24, Nov. 1981, p. 1025-1037. 21 refs. Research supported by the National Science Council of the Republic of China.

A current-voltage characteristic is derived for the high-low emitter solar cell in concentrated sunlight. For high-level injection, the ambipolar approach is used to yield the complete information of the low emitter concentration region, including the ohmic drop, the Dember voltage, the minority carrier current density, the minority-carrier distribution, and the electric field distribution. High doping effects including Auger recombination and bandgap narrowing are considered. The dependences of short-circuit current, open-circuit voltage, fill factor, and conversion efficiency on the variations of the geometrical dimensions and material parameters are discussed in detail for silicon single crystal materials. It is shown that the maximum conversion efficiency of 22% at 100 suns (AMO) can be obtained for silicon high-low emitter solar cell. (Author)

A82-15442 A pinhole model for metal-insulator-semiconductor solar cells. A. Rothwarf (Drexel University, Philadelphia, PA) and I. Pereyra (Delaware, University, Newark, DE). *Solid-State Electronics*, vol. 24, Nov. 1981, p. 1067-1070. 22 refs. Contract No. DE-AC01-79ET-23107-01.

Based upon a consideration of the standard theory of MIS solar cells and the experimental results on such devices, the concept of tunneling through the thin insulating layer as the controlling mechanism is rejected. In place of the tunneling mechanism the concept of parallel Schottky diodes through pinholes in the insulator is proposed. The mathematical formulation fits this proposal. The characteristics and limits of efficiency expected for such a pinhole MIS are explored and found to be in good accord with existing results on experimental diodes. The equations needed to specify the density and size of the pinholes needed for optimal efficiency are formulated but not solved. A suggestion to test the hypothesis by artificially producing pinhole devices is proposed. (Author)

A82-15444 Effect of junction depth on the performance of a diffused n/+/p silicon solar cell. P. C. Dhanasekaran and B. S. V. Gopalam (Indian Institute of Technology, Madras, India). *Solid-State Electronics*, vol. 24, Dec. 1981, p. 1077-1080. 17 refs.

A82-15447 Theory of back surface field silicon solar cells. S. R. Dhariwal (Government College, Ajmer, India) and A. P. Kulshreshtha (Indian Space Research Organization, Satellite Centre, Bangalore, India). *Solid-State Electronics*, vol. 24, Dec. 1981, p. 1161-1165. 12 refs. Research supported by the Department of Space and Space Commission.

A theory has been developed which explains the behavior of back surface field (BSF) silicon solar cells with n+pp+ or p+nn+ structure. The theory is based on the calculation of the open circuit voltage of a BSF cell by considering the charge neutrality condition with drift of both the majority and minority carriers, whereas previous theories have emphasized the flow of minority carriers alone. It is shown that the open circuit voltage of a BSF cell is almost independent of the base layer resistivity at high levels of injection. It is also shown that the enhancement of the open circuit voltage of a high resistivity cell is more apparent in n+pp+ than in p+nn+ structure, because the former gives lower voltages in the non-BSF structure. V.L.

A82-15607 Bounds and exact theories for the transport properties of inhomogeneous media. R. C. McPhedran and G. W. Milton (Sydney, University, Sydney, Australia). *Applied Physics A - Solids and Surfaces*, vol. A 26, Dec. 1981, p. 207-220. 39 refs. Research supported by the Science Foundation for Physics.

The reported investigation is concerned with the transport properties of an inhomogeneous substance composed of two different materials, the composite being macroscopically homogeneous. The problem arises in connection with the calculation of the optical properties of cermets for solar energy applications. It is also important in mechanical engineering for the study of the properties of composites. Subclasses of the problem include the scalar and the vector case. The investigation is mainly concerned with scalar problems, taking into account rigorous methods. Attention is given to two approaches. One approach is concerned with the calculation of bounds regarding the transport properties. The second approach involves a consideration of specific periodic structures and the exact solution of the transport problem. It is the principal aim of the investigation to demonstrate the unity of these two approaches. G.R.

A82-15642 † Method for calculating the unsteady temperature conditions of the generator in a solar refrigeration system (Metod rascheta nestatsionarnogo temperaturnogo rezhima generatora solnechnoi kholodil'noi ustanovki). B. M. Achilov, V. V. Chugunkov, and R. M. Mirzakhodzhaev (Bukharskii Gosudarstvennyi Pedagogicheskii Institut, Bukhara, Uzbek SSR). *Akademiia Nauk Uzbekskoi SSR, Doklady*, no. 8, 1981, p. 32-34. In Russian.

A82-15653 Calculation of the top loss coefficient by the network method and applications to solar collectors. T. Muneer and M. Hawas (University of Garyounis, Benghazi, Libya). *Energy* (UK), vol. 6, Oct. 1981, p. 971-981. 10 refs.

A technique for the analysis of radiation exchange between two parallel planes with an intervening transmitting-absorbing-reflecting medium is extended to include convective heat transfer in the case of flat-plate solar collectors. The radiation exchange between the absorber plate of the collector and the sky is analyzed by a network method. Two network elements represent the surface and space resistances, which model the exchange of radiant energy between any two surfaces. The heat flow in each branch of the network is determined by application of Kirchhoff's Law to the circuit with the algebraic sum of the currents at each node set at zero. A flow chart is provided for the solution of the network, and radiosities and emissive powers are found for various plastic and glass covers including all paths of heat transfer loss. Top loss coefficients are derived and the method is proved reliable for calculation of the temperature of any cover and the heat exchange between two surfaces. M.S.K.

A82-15660 Introduction of solar energy in Saudi Arabia - A case study. A. I. El-Sharkawy (King Abdulaziz University, Jeddah, Saudi Arabia), A. A. Husseiny, and R. Kenarangui (Iowa State University of Science and Technology, Ames, IA). *Journal of Engineering and Applied Sciences*, vol. 1, no. 1, 1981, p. 41-55. 5 refs.

Policies for the introduction of solar energy in Saudi Arabia are examined. Differentiation is made between areas of low density (nomadic) and high density (urban) population. Five strategies are considered which encompass the evolution from overall dependence on fossil fuel to a total energy system solely based on solar energy. Use is made of the multiattribute utility theory in the decision analysis of the various strategies. (Author)

A82-15666 A solar heating system with annual storage. F. Lazzari and G. Raffellini (Bologna, Università, Bologna, Italy). *International Journal of Ambient Energy*, vol. 2, July 1981, p. 141-149.

A solar heated house with long term storage capability, built in Trento, Italy, is described. The one story house was built from modular components and has a total heated volume of 1130 cu m. Flat plate solar collectors with a water-antifreeze medium are located beneath the lawn, and six cylindrical underground tanks holding 130 cu m of water heated by thermal energy from the collectors are situated under the garden. The house walls have an 8 cm cavity filled with 5 cm of formaldehyde foam, yielding a heat transmission (U) of 0.37 W/sq m/deg C. The roof and ceilings are insulated with fiberglass and concrete, producing U-values of 0.46 W/sq m/deg C and 0.57 W/sq m/deg C, respectively. Heat pumps using 6 kW move thermal energy between the house and the tanks. Direct hot water heating occurs in the summer, and direct home heating when the stored water temperature exceeds 32 C. A computer model was developed which traces the annual heat flow and it is shown that the system supplies all heating requirements for the house, with electrical requirements equal to 20 percent of the annual house needs. M.S.K.

A82-15803 * Towards a high-temperature solar electric converter. G. J. Dunning and A. J. Palmer (Hughes Research Laboratories, Malibu, CA). *Journal of Applied Physics*, vol. 52, Dec. 1981, p. 7086-7091. 10 refs. Contract No. NAS2-10001.

The concept of an ultrahigh-temperature solar electric heat-engine converter is examined in which an alkali plasma would serve

as both the high-temperature collector of solar radiation and as the working fluid for a high-temperature working cycle. The working cycle would be a simple magnetohydrodynamic Rankine cycle. Theoretical and experimental results obtained to date are summarized. These include: (1) an experimental confirmation of the theoretical prediction that a plasma temperature of about 2800 K can be reached through heating cesium vapor by sunlight concentrated to approximately 300 W per sq cm; and (2) the establishment of a theoretical model of the complete solar heated plasma magnetohydrodynamic cycle. V.L.

A82-15911 A new structure for a semiconductor-insulator-semiconductor solar cell. K. Sen and R. S. Srivastava (D. B. S. College, Dehradun, India). *Journal of Applied Physics*, vol. 52, Dec. 1981, p. 7309-7312. 7 refs.

The open circuit voltage and short circuit current characteristics of S(p + n)IS, a new structure proposed for semiconductor-insulator-semiconductor solar cells, are calculated and compared with those of the S(n+)IS type solar cells. It is found that the theoretical conversion efficiency of the new structure with polycrystalline base is about 30% and its open circuit voltage is of the order of 1.3 V, which is much higher than for a polycrystalline S(n+)IS solar cell. V.L.

A82-16051 Grain size dependence of the photovoltaic properties of solar grade polysilicon. S. Kumari, N. K. Arora, and G. C. Jain (National Physical Laboratory of India, New Delhi, India). *Solar Energy Materials*, vol. 5, Oct. 1981, p. 383-390. 20 refs.

The effect of grain size on the various photovoltaic and diode parameters of polycrystalline silicon solar cells is investigated. The grain size ranged from 0.3-3 mm, and the solar cells were fabricated on 22 mm diameter and 300 micron thick polycrystalline Si wafers with a resistivity of about 10 ohm cm. The solar grade polysilicon has an impurity concentration as high as 10 to the 16th - 10 to the 17th/cu cm, with iron as the major impurity. The variation of efficiency and diffusion length with grain size was found to shift to higher grain size ranges in solar cells made out of solar grade poly-Si. This is a result of the increased detrimental effects of grain boundaries in solar grade poly-Si, since the excess impurities segregate at the grain boundaries. A study of dark I-V characteristics shows that the grain boundaries do not appreciably affect bulk recombination, but do enhance the contribution of the space charge recombination. J.F.

A82-16053 Photoelectrochemical cells using polycrystalline and thin film MoS2 electrodes. G. Djemal, U. Lachish, D. Cahen (Weizmann Institute of Science, Rehovot, Israel), and N. Müller. *Solar Energy Materials*, vol. 5, Oct. 1981, p. 403-416. 21 refs. Research supported by the European Communities Energy Research and Development Program and U.S.-Israel Binational Science Foundation.

The preparation and preliminary characterization of a variety of photoactive polycrystalline MoS2 electrodes in polyiodide aqueous electrolyte are reported. The best photoresponse results were obtained when multicrystalline lumps were affixed to metal substrates; pressed pellets reached about 30% of the output of these electrodes. Thin polycrystalline films were prepared by flux annealing of pasted films; these showed some photoresponse, which was improved by more than an order of magnitude if an organic polymer binder was used in the preparation and retained by low temperature annealing. These electrodes reached 50% of the output of pressed pellets. The effect of the polymer is due to (1) orientation of the crystallites, and (2) shielding of some of the exposed edges from the solution. Prolonged use of these photoelectrodes or short use at higher temperatures will decrease their output, but the original activity can be restored by renewed low temperature annealing. The wavelength dependence of the photoresponse of these electrodes shows that those using a polymer matrix approach the performance of single crystals most closely. J.F.

A82-16054 A study of the purification process during the elaboration by electron bombardment of polysilicon ribbons designed for photovoltaic conversion. D. Casenave, R. Gauthier, and P. Pinard (Lyon, Institut National des Sciences Appliquées, Villeurbanne, Rhône, France). *Solar Energy Materials*, vol. 5, Oct. 1981, p. 417-423. 10 refs. Research supported by the Centre National de la Recherche Scientifique and Agence Nationale de Valorisation de la Recherche.

A method of elaboration of polysilicon ribbons for solar energy conversion has been developed, which uses powder as a starting material. The method is characterized by its low energy costs, its high pulling rates, and its elimination of substrate contamination. Ribbons with small grains (of the order of 100 microns) are obtained in the first melting process from the powder. The ribbons are then recrystallized under an electron beam, giving elaborated polycrystalline samples with a columnar structure and an average thickness of 400 microns. Electron irradiation at low pressure leads to two simultaneous processes of purification, one resulting from the displacement of the molten zone produced on the sample by the electron beam, the other operating by evaporation of impurities in vacuum. J.F.

A82-16055 Solar selective properties and high temperature stability of CVD ZrB2. E. Randich and R. B. Pettit (Sandia National Laboratory, Albuquerque, NM). *Solar Energy Materials*, vol. 5, Oct. 1981, p. 425-435. 16 refs. Contract No. DE-AC-04-76DP-00789.

The aging at temperatures of 400, 500, and 600 C in air is examined for chemical vapor deposited (CVD) zirconium diboride (ZrB2) and zirconium diboride coatings overcoated with silicon nitride (Si3N4). The solar absorptance and emittance properties of polished CVD ZrB2 on high-density, hot-pressed ZrB2 are also reported. Antireflection coatings of Si3N4 increased the solar absorption of CVD ZrB2 from initial values of 0.46-0.77 to 0.88-0.93, while only increasing the emittance from 0.08 to 0.10. Aging tests show the Si3N4/ZrB2 combination, both free standing and on Kovar substrates, to be stable in air at 500 C for greater than 1000 h; but at 600 C, the emittance increased after 300 h exposure. This slow degradation at 600 C appears to result from oxidation of the Si3N4 antireflection layer. J.F.

A82-16056 Photocorrosion of strontium titanate photoanodes. C. W. de Kreuk, J. L. B. de Groot (Centrale Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Centraal Laboratorium TNO, Delft, Netherlands), and A. Mackor (Centrale Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Organisch Chemisch Instituut TNO, Utrecht, Netherlands). *Solar Energy Materials*, vol. 5, Oct. 1981, p. 437-444. 13 refs. Research supported by VEG-Gasinstituut.

The photocorrosion of a strontium titanate photoanode was studied under acidic (0.5 M H2SO4), neutral (0.5 M Na2SO4), and alkaline (1.0 M NaOH) conditions. It was found that in the 0.5 M H2SO4 acid medium, SrTiO3 corrodes very rapidly upon band-gap irradiation (at a potential of 1 V) with an external bias. Assuming the photocorrosion to be a two-hole process releasing strontium ions, the corrosion corresponded to 10% of the photocurrent. No substantial corrosion was found in the dark or under open-circuit conditions. In the neutral medium the corrosion was less severe; chipping of the crystal surface was observed (thickness of about 0.2-0.4 microns), due to the loss of strontium. No substantial corrosion was found under alkaline conditions. J.F.

A82-16057 Sputter etched metal solar selective absorbing surfaces for high temperature thermal collectors. G. L. Harding and M. R. Lake (Sydney, University, Sydney, Australia). *Solar Energy Materials*, vol. 5, Oct. 1981, p. 445-464. 31 refs. Research supported by the University of Sydney.

Magnetron sputter etching was used to successfully texture copper, stainless steel, and nickel in the form of sheets (280 mm x 50 mm) and tube (280 mm in length). The various surfaces exhibited absorptances in the range of 0.90 to 0.95 and emittances in the range of 0.10 to 0.25 at 300 K. In the case of copper, surface morphologies and solar selectivity varied with sputter etching parameters, allowing tailoring of selective properties. Surfaces produced on stainless steel and nickel were less dependent on sputtering conditions. Sputter-etched copper surfaces were stable in vacuum at 400 C; sputter-etched stainless steel surfaces were stable at 500 C and deteriorated slowly in air at 400 C; surfaces based on nickel deteriorated slowly in air even at 300 C. Measurements of the dependence of absorptance on angle of incidence show that textured specimens produced by

sputter etching behave similarly to a highly specular sputtered selective surface. The magnetron sputtering techniques can also be extrapolated to produce solar absorbers having an axial length of about 2 m. J.F.

A82-16124 **Solar chemistry of metal complexes.** H. B. Gray (California Institute of Technology, Pasadena, CA) and A. W. Maverick (Washington University, St. Louis, MO). *Science*, vol. 214, Dec. 11, 1981, p. 1201-1205. 41 refs.

Electronic excited states of certain transition metal complexes undergo oxidation-reduction reactions that store chemical energy. Such reactions have been extensively explored for mononuclear complexes. Two classes of polynuclear species exhibit similar properties, and these complexes are now being studied as possible homogeneous sensitizer-catalysts for hydrogen production from aqueous solutions. (Author)

A82-16127 **High efficiency inversion layer solar cells on polycrystalline silicon by the application of silicon nitride.** R. Schörner and R. Hezel (Erlangen-Nürnberg, Universität, Erlangen, West Germany). *IEEE Transactions on Electron Devices*, vol. ED-28, Dec. 1981, p. 1466-1469. 15 refs.

A82-16131 **A method for experimental assessment of the shifting approximation, with application to polysilicon solar cells.** J. A. Mazer (Harris Semiconductor, Inc., Palm Bay, FL), A. Neugroschel, and F. A. Lindholm (Florida, University, Gainesville, FL). *IEEE Transactions on Electron Devices*, vol. ED-28, Dec. 1981, p. 1530-1534. 6 refs. Contract No. XS-9-8275-1.

The method makes use of the fact that, in a solar cell for which the shifting approximation is valid, a constant series resistance, independent of illumination, will cause the light and dark I-V curves to be symmetrically displaced with respect to the I sub SC-V sub OC curve. This symmetry is analyzed in detail. The experimental data are seen as suggesting that the shifting approximation is valid and that the series resistance is independent of illumination up to at least one-sun intensity for a variety of polysilicon solar cells in which the intragrain-base minority carrier diffusion length is less than or equal to the average grain diameter. C.R.

A82-16132 **K/u/-band flat-profile Si-IMPATT diodes with 10-percent efficiency.** D. Leistner and J. Freyer (München, Technische Universität, Munich, West Germany). *IEEE Transactions on Electron Devices*, vol. ED-28, Dec. 1981, p. 1553, 1554. 8 refs. Research supported by the Fraunhofer Gesellschaft zur Förderung der angewandten Forschung.

A82-16133 **Influence of the junction area to edge area ratio on the open-circuit voltage of silicon solar cells.** A. Cuevas, J. Eguren, E. Sánchez, and M. Cid (Madrid, Universidad Politécnica, Madrid, Spain). *IEEE Transactions on Electron Devices*, vol. ED-28, Dec. 1981, p. 1554, 1555. 5 refs.

A82-16229 **Thermal performance of a solar still.** M. S. Sodha, J. K. Nayak, G. N. Tiwari (Indian Institute of Technology, New Delhi, India), and U. Singh. *Journal of Energy*, vol. 5, Nov.-Dec. 1981, p. 331-336. 19 refs.

A simple periodic analysis of a basin-type solar still (both single as well as double), mounted on a stand, has been presented. The effect of dye injected into the water of a single-basin still has been explained. Numerical calculations have been carried out using parameters corresponding to stills with which experiments have been carried out at the Indian Institute of Technology, Delhi. It is found that the present theory quite satisfactorily explains the thermal performance of basin-type solar stills. (Author)

A82-16247 **An integrating sphere based on absolute method for measuring solar absorptance.** X. Ge (China University of Science and Technology, Hefei, People's Republic of China) and Y. Peng (Chinese Academy of Sciences, Shanghai Institute of Ceramics, Shanghai, People's Republic of China). *Engineering Thermophysics in China*, vol. 1, Oct.-Dec. 1981, p. 347-366. 32 refs. Translation.

In this paper, an integrating sphere for measuring solar absorptance is described. Its characteristics are: (1) it is an absolute method; (2) it can be used to measure the directional-hemispherical reflectance for various incidence angles; (3) the samples to be measured may be specular, diffuse or specular-diffuse reflecting surfaces. Theoretical analyses are carried out for this integrating sphere and the measured data of reflectance of the MgO, vacuum-vaporized aluminum mirror film and other surfaces are presented. (Author)

A82-16240 **Natural convection in air layers at various aspect ratios and angles of inclination.** D. Luo and L. Han (Qinghua University, Beijing, People's Republic of China). *Engineering Thermophysics in China*, vol. 1, Oct.-Dec. 1981, p. 385-397. 17 refs. Translation.

The results of an experimental investigation of natural convection in air layers at various aspect ratios and angles are presented. The Rayleigh numbers range from subcritical to 1,000,000; the angle of inclination, measured from the horizontal, ranges from 0 to 90 deg. From an analysis of the physical model and the experimental measurements, several experimental nondimensional formulas are proposed. Special attention is given to the influence of the aspect ratio on heat transfer. The influence is found to differ with the range of the aspect ratio, being more pronounced in the range of low aspect ratios. The applicability of the recommended relationships to the design of solar collectors is stressed. C.R.

A82-16469 **Effects of heat treatment on epitaxial silicon solar cells on metallurgical silicon substrates.** T. L. Chu, S. S. Chu (Southern Methodist University, Dallas, TX), L. L. Kazmerski, R. Whitney (Solar Energy Research Institute, Golden, CO), C. L. Lin, and R. M. Davis (Poly Solar, Inc., Garland, TX). *Solar Cells*, vol. 5, Dec. 1981, p. 29-38. 7 refs. Contract No. XZ-0-9192-1.

A preparation of acid extracted metallurgical grade silicon as a large-grain substrate for solar cells is described. Metallic impurities which normally accumulate on the grain boundaries of pulverized Si were removed by 400 hr of aqua regia refluxing. Secondary ion mass spectrometry (SIMS) revealed that aluminum and iron concentrations were significantly reduced, and the Si was made into sheets by unidirectional solidification on an RF-heated graphite plate. Solidification at 1-2 cm/min yielded a (110) crystallite orientation; SIMS determined that remaining impurities were uniformly diffuse, and heat treatment in He at 700 C resulted in precipitation of metallic impurities onto the grain boundaries. Trichlorosilane was thermally reduced to form an epitaxial film on the Si substrate, and 37 sq cm cells were fabricated with an efficiency of 8.95%. M.S.K.

A82-16471 **n-/indium tin oxide//p-InP solar cells.** L. Goussov, H. Luquet, J. Esta, and C. Gril (Montpellier II, Université, Montpellier, France). *Solar Cells*, vol. 5, Dec. 1981, p. 51-66. 17 refs.

n-(indium tin oxide)/p-InP solar cells of 11 percent efficiency were fabricated using the spray method to deposit indium tin oxide onto single-crystal p-type InP. For the atomic ratio Sn:In of 1:10, the optimized spray temperature is 450 C. The various characterizations made on this type of device give results which are in good agreement with a buried homojunction model. (Author)

A82-16472 **Effects of double-exponential current-voltage characteristics on the performance of solar cells.** A. H. M. Shousha (United Arab Emirates University, Al Ain, United Arab Emirates). *Solar Cells*, vol. 5, Dec. 1981, p. 67-73. 10 refs.

The effects of double-exponential dark current-voltage characteristics on the open-circuit voltage, fill factor and conversion efficiency of solar cells were investigated with reference to MIS solar cells. The results presented show various types of cell performance depending on the relative contributions of the postulated current transport mechanisms. (Author)

A82-16474 **Effects of processing parameters on thick film inks used for solar cell front metallization.** K. Firor and S. Hogan (Solar Energy Research Institute, Golden, CO). *Solar Cells*, vol. 5, Dec. 1981, p. 87-100. 9 refs.

A study is described of commercially available thick film conductor inks to determine their suitability for use as solar cell front electrical contacts. By varying processing parameters such as firing profile and length of HF etch, most of the silver-based inks were found to form good electrical contacts. Irrespective of ink

composition, adjustment of processing parameters is necessary to optimize the performance of a thick film solar cell contact. The base metal conductor inks tested were found to be unsuitable for solar cell front metallization. The two major problems encountered were high diffusivities in silicon and high series resistances introduced by the base metal contacts. (Author)

A82-16596 A seasonally adjusted concentrator with modifications of absorber shape. S. C. Mullick and S. K. Nanda (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 9, Dec. 1981, p. 257-266. 14 refs.

A design procedure for a solar collector absorber is described, which avoids the optical losses which occur through the air gap. A comparison of the performance results of this modified absorber with those of a plane tubular absorber shows an improvement in the intercept factor from 0.8 to 0.92. The surface area of the modified absorber is about 9% larger than the surface of the plane tubular absorber, but the shape is such that the overall heat loss factor is much lower: the total heat loss for the modified absorber at 100 C above ambient is only 0.2% higher than that of the plane tubular one. Performance curves of both absorbers are given, demonstrating the improved efficiency of the modified absorber. J.F.

A82-16599 Theoretical analysis of the Fresnel lens as a function of design parameters. P. K. Gupta (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 9, Dec. 1981, p. 301-310. 7 refs.

The theoretical performance of the Fresnel lens was studied as a function of the design parameters - i.e., the radius to the center of the steps, the focal distance from the back of the lens to the plane of the image with the object (i.e., the sun) at infinity, the thickness of the lens plate, the step width and the refractive index of the material (with respect to air) - used in its fabrication. Numerical calculations have also been carried out for a Fresnel lens of perspex sheet. (Author)

A82-16742 Photoanode on the base of pheophytin-sensitized reactions. E. Iu. Kats, Iu. N. Kozlov, and B. A. Kiselev (Academy of Sciences, Institute of Photosynthesis, Pushchino, USSR). *Energy Conversion and Management*, vol. 21, no. 3, 1981, p. 171-174. 18 refs.

A model of a photoelectrochemical fuel element for photoionized reduction of methylviologen is presented, along with experimental results. The photoanode is described on a basis of pheophytin-sensitized oxidation of manganese ions, with tetranitromethane used as an irreversible electron acceptor. Use of a platinum electrode and preparation of the chemical redox agents is described, and a polarographic cell at 20 C illuminated by a 750 W iodine lamp was investigated. The addition of water or Mn ions to the solution in the photogalvanic cell led to total tetranitromethane reduction. The pheophytin-sensitized reduction of MN ions permitted an open current voltage of 750 mV and a short circuit photocurrent of 100 micro-A/sq cm. The recombination of reaction products is inhibited by the irreversible tetranitromethane reduction, which is a drawback for use of the system. M.S.K.

A82-16744 Optimization of heat losses in normal and reverse flat-plate collector configurations - Analysis and performance. M. Madhusudan, G. N. Tiwari, D. S. Hrishikeshan, and H. K. Sehgal (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 3, 1981, p. 191-198. 6 refs.

A82-16745 Nickel sulphide-lead sulphide and nickel sulphide-cadmium sulphide selective coatings for solar thermal conversion. M. Madhusudan and H. K. Sehgal (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 3, 1981, p. 199-204. 6 refs.

A82-17098 * Low cost silicon-on-ceramic photovoltaic solar cells. B. G. Koepke, J. D. Heaps, B. L. Grung, J. D. Zook (Honeywell Corporate Material Sciences Center, Bloomington, MN), J. D. Sibold (Coors Porcelain Co., Golden, CO), and M. H. Leipold (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Energy and ceramics. Amsterdam, Elsevier Scientific Publishing Co., 1980, p. 1146-1158. 23 refs. Research sponsored by the U.S. Department of Energy and NASA.

A technique has been developed for coating low-cost mullite-based refractory substrates with thin layers of solar cell quality silicon. The technique involves first carbonizing one surface of the ceramic and then contacting it with molten silicon. The silicon wets the carbonized surface and, under the proper thermal conditions, solidifies as a large-grained sheet. Solar cells produced from this composite silicon-on-ceramic material have exhibited total area conversion efficiencies of ten percent. (Author)

A82-17099 The use of semiconducting oxide ceramics in solar energy conversion. I. R. Bedwell and E. R. McCartney (New South Wales, University, Kensington, Australia). In: Energy and ceramics. Amsterdam, Elsevier Scientific Publishing Co., 1980, p. 1159-1172. 18 refs.

N-type oxide semiconductors in such forms as single-crystal slices and sintered compacts of rutile and hematite are studied, with a view to their use as photo-anodes in photogalvanic and photoelectrolytic solar cells. Slices of single-crystal hematite displayed anisotropic behavior in the photogalvanic mode, with higher currents obtained by an (012) slice than those having other orientations. Photoresponse variations were also found in hematite compacts, depending on the origin of the iron oxide used, and quantum efficiencies in the 1-5% range were measured. Other aspects of the research reported are: (1) AC and DC conductivity, (2) the effect of ohmic constant, (3) photocurrent as a function of bias voltage, and (4) long-term stability. O.C.

A82-17126 The design of a sodium-cooled 2.7 MW receiver for a solar power plant (Auslegung eines natriumgekühlten 2,7 MW-receivers für ein Sonnenkraftwerk). D. Stahl, H. Weizenkamp (Interatom Internationale Atomreaktorbau GmbH, Bensberg, West Germany), and H. Fricker (Gebrüder Sulzer AG, Winterthur, Switzerland). *Brennstoff-Wärme-Kraft*, vol. 33, Nov. 1981, p. 451-454. In German.

The design of the sodium-cooled 2.7 MW receiver, installed at the solar power plant in Almeria, Spain, is described. Particular attention is given to the receiver requirements, its construction, and its thermodynamic and dynamic response to solar radiation. The receiver has a thermal output of 2.7 MW, maximum and minimal sodium flow rates of 7.34 kg/sec and 0.734 kg/sec, respectively, and sodium inlet and outlet temperatures of 270 C and 530 C, respectively. The geometry of the receiver includes an active thermally conducting wall, formed from a 120 deg portion of a vertical cylinder with a radius of 2.25 m and a height of 3.61 m; the maximum heat flux reaches a value of about 62 W/sq cm, the average being about 16 W/sq cm. The total thermal efficiency at 100% load is 88.3%; this efficiency decreases steadily, due to the constant sodium outlet temperature and the constant radiation, convection, and line losses. Out of sunlight, the receiver cools down from radiation losses of about 320 kW; the maximum temperature transient is about 2 k/sec. J.F.

A82-17128 Solar-thermal experimental projects on the Spanish Plataforma Solar (Solarthermische Versuchsvorhaben auf der spanischen Plataforma Solar). W. Grasse (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Cologne, West Germany). *DFVLR-Nachrichten*, Nov. 1981, p. 6-10. In German.

The Plataforma Solar with an area of 1,000,000 sq m is located in Spain at a distance of approximately 50 km from the Mediterranean. In May 1979, nine members of the International Energy Agency (IEA) decided to support the construction of Small Solar Power Systems (SSPS). The countries involved include West Germany, the U.S., Spain, and Italy. The SSPS are to demonstrate the operational feasibility of solar technologies which have been mainly developed in Germany and the U.S. In addition, data are to be obtained regarding the relative competitive position of two different operational concepts for SSPS. The concepts are related to the central receiver system (solar tower) and the distributed collector system. Attention is also given to the Spanish solar power station CESA-1 and the German-Spanish technology program GAST, which is to explore the technological limits of solar-energy systems. G.R.

A82-17252 **Metallurgical analysis and high temperature degradation of the black chrome solar selective absorber.** C. M. Lampert (California, University, Berkeley, CA). *(Thin Solid Films,* vol. 72, 1980, p. 73-81.) In: Metallurgical coatings 1980; Proceedings of the Seventh International Conference, San Diego, CA, April 21-25, 1980. Volume 1. Lausanne, Elsevier Sequoia, S.A., 1980, p. 73-81. 13 refs. Contract No. W-7405-eng-48.

A commercially produced coating is used in scrutinizing the properties and degradation modes of black chrome that is exposed to high temperatures. Both asplated and annealed microstructural models are studied. In the microstructural characterization, the technical means comprise scanning electron microscopy, transmission electron microscopy, Auger depth profiling, hemispherical reflectance measurements, and energy-dispersive X-ray analysis. From these results, a physical metallurgical model for the wavelength-selective properties of the coating is developed. It is found that black chrome degrades as Cr2O3 oxide particles grow and the chromium is depleted. The effect is pronounced in air, less noticeable in a medium vacuum. It is noted that oxidation by preferential diffusion and outgassing which causes structural changes may take place. C.R.

A82-17253 **Sputter-deposited Al2O3/Mo/Al2O3 selective absorber coatings.** J. A. Thornton, A. S. Penfold, and J. L. Lamb (Telic Corp., Santa Monica, CA). *(Thin Solid Films,* vol. 72, 1980, p. 101-109.) In: Metallurgical coatings 1980; Proceedings of the Seventh International Conference, San Diego, CA, April 21-25, 1980. Volume 1. Lausanne, Elsevier Sequoia, S.A., 1980, p. 101-109. 16 refs. Research supported by the U.S. Department of Energy.

An investigation of Al2O3/Mo/Al2O3 (AMA) interference type selective absorber coatings deposited by cylindrical magnetron sputtering onto low emittance molybdenum-coated glass and stainless steel substrates is presented. Both post- and hollow-cathode magnetrons were used. The Al2O3 layers were formed by reactive sputtering from aluminum and by RF sputtering from alumina targets. The semitransparent molybdenum intermediate layers were deposited with and without oxygen injection. The optical constants for the individual sputtered layers were determined from transmission and reflectance measurements, and were used to calculate the influence of these layers on the solar absorptance of the complete AMA coating. The optical properties of the sputtered AMA layers were in reasonable agreement with theory, yielding hemispherical solar absorptances of 0.92-0.95 with total hemispherical emittances of 0.06-0.10 at 20 C. The highest absorptances and the lowest emittances were obtained for coatings in which the center molybdenum layer had been deposited with oxygen addition. The thermal stabilities of coatings with RF-sputtered Al2O3 were superior to those with reactively sputtered Al2O3. AMA coatings on stainless steel with an Al2O3 diffusion barrier were stable (less than 2% loss in absorptances) at 700 C in vacuum and at 550 C in air. These coatings are therefore attractive for a range of selective absorber applications, including high temperature collectors for use between 300 and 600 C. (Author)

A82-17254 **Characterization of selective solar absorber microstructures - Electron microscope studies.** L. E. Murr, O. T. Inal, and M. Valayapetre (New Mexico Institute of Mining and Technology, Socorro, NM). *(Thin Solid Films,* vol. 72, 1980, p. 111-120.) In: Metallurgical coatings 1980; Proceedings of the Seventh International Conference, San Diego, CA, April 21-25, 1980. Volume 1. Lausanne, Elsevier Sequoia, S.A., 1980, p. 111-120. 8 refs. Contract No. ER-78-84-4266.

A82-17255 **Oxidation of electrodeposited black chrome selective solar absorber films.** P. H. Holloway, K. Shanker (Florida, University, Gainesville, FL), R. B. Pettit, and R. R. Sowell (Sandia National Laboratory, Albuquerque, NM). *(Thin Solid Films,* vol. 72, 1980, p. 121-128.) In: Metallurgical coatings 1980; Proceedings of the Seventh International Conference, San Diego, CA, April 21-25, 1980. Volume 1. Lausanne, Elsevier Sequoia, S.A., 1980, p. 121-128. 15 refs. Contracts No. DE-AC04-76DP-00789; No. DE-FG02-79ER-10541.

A82-17293 **Aplanatic double reflection system for thermophotovoltaic applications - Design.** F. Demichelis, E. Minetti-Mezzetti (Torino, Politecnico, Turin, Italy), and G. Ferrari (Fiat S.p.A., Centro Ricerche, Turin, Italy). *Applied Optics,* vol. 20, Dec. 15, 1981, p. 4190-4192.

An aplanatic double-reflection concentrator which is relatively inexpensive and provides a highly concentrated output beam has been developed for applications in thermophotovoltaic solar energy systems. The configuration consists of a spherical primary reflector and a field of Fresnel mirror secondary reflectors deployed on a spherical surface so that the Abbe sine condition is satisfied, eliminating both spherical aberration and coma. Optical analysis of such a system has resulted in the design of a solar collector for a thermophotovoltaic converter which concentrates a power of 1000 W on the absorber through an aperture of 0.01 m, and has demonstrated its suitability for high-temperature solar systems. A.L.W.

A82-17294 **Finite Lambertian source analysis of concentrators - Application to solar reflectors.** A. Luque and J. M. Gómez (Madrid, Universidad Politécnica, Madrid, Spain). *Applied Optics,* vol. 20, Dec. 15, 1981, p. 4193-4200. 6 refs.

The Lambertian source characteristics of solar reflectors operating in concentrating collectors are considered. The figures of merit of a given concentrator are analyzed with respect to its behavior in casting the incident power into the collector (intercept factor) and its ability to illuminate the collector as a Lambertian source (shape quality factor), and it is shown that the maximum power is cast on the collector when the concentrator is seen as a Lambertian source. The intercept factor of ideal mirrors, defined as those mirrors casting all received rays onto the receiver, are examined in the case of inaccuracies in concentrator shape, and it is found that all outlines become Lambertian when the tracking error is high enough. A method for cost analysis is presented which leads to the conclusion that mirrors with quality factors close to the Lambertian should be used for high-cost collectors, while mirrors with intercept factors close to those of the ideal should be used if the concentrator cost is high. A.L.W.

A82-17649 **A comparison of p-i-n and Schottky barrier hydrogenated amorphous silicon, a-Si:H, solar cells.** R. S. Crandall (RCA Laboratories, Princeton, NJ). *RCA Review,* vol. 42, Sept. 1981, p. 441-457. 16 refs. Research supported by RCA; Contract No. XG-0-9372-1.

Measurements of the photoconductive response of Schottky barrier and p-i-n solar cell structures made from hydrogenated amorphous silicon are presented to compare the properties that determine their efficiency. It is demonstrated that the photoconductivity determines the fill factor rather than the dark current, as in crystalline silicon cells. Analysis of the current voltage curves of the p-i-n cells are used to show that the electron and hole drift lengths are of the same order in the i layer of the cell. (Author)

A82-17650 **Field nonuniformity due to photogenerated carriers in a p-i-n solar cell.** R. S. Crandall (RCA Laboratories, Princeton, NJ). *RCA Review,* vol. 42, Sept. 1981, p. 458-462. 10 refs. Research supported by RCA; Contract No. XG-0-9372-1.

The changes in the electric field due to the free-carrier space charge in a p-i-n solar cell are calculated. A criterion for significant field reduction caused by space charge is presented. It is suggested that there will be significant electric field lowering for hydrogenated amorphous silicon, a-Si:H, solar cells much thicker than 1 micron under 1 sun illumination. (Author)

A82-17781 **The El Paso electric 20-kilowatt photovoltaic system.** V. V. Risser and S. Durand (New Mexico Solar Energy Institute, Las Cruces, NM). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0064.* 8 p.

Features and operational characteristics of a 20 kW flat plate photovoltaic power system are described. The system powers computers which control a combined cycle 190 MW power plant. Performance has been an average of 93 kWh/day, 6.05% efficiency, and at an average cell temperature of 22 C from Dec. 1980 to Sept. 1981. The array comprises 279 sq m area, 64 panels, 6 subarrays for subsystem shorting if necessary, and fuses set at 250 V with a reaction time of 10 microsec. Testing procedures are outlined,

including data acquisition, weather monitoring, operation in cloudy periods, and fault isolation modes. Maintenance has been dominated by upkeep of the data acquisition system, and it is noted that significant reductions in all maintenance would have results in only minor reductions in overall system performance. M.S.K.

A82-17762 # **The Mt. Laguna photovoltaic project.** L. R. Suelzle (Helionetics, Inc., Irvine, CA) and D. E. Haskins (Sandia National Laboratory, Albuquerque, NM). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0065.* 7 p. 6 refs.

The Mt. Laguna 60 kW photovoltaic project was completed and placed in operation in June of 1979. During the first two years of operation the photovoltaic system has met or exceeded most of the technical requirements originally established with virtually no problems. The electrical output from the photovoltaic array however, has suffered a slow but consistent decline during the 2-year operational period. Fortunately, the load on the grid has declined at a still greater rate so that the percentage of the load carried by the photovoltaic system has increased from 10% to about 20%. This paper addresses the 2 years of operations and analyzes the overall performance and effectiveness of the system during that time. (Author)

A82-17764 # **The Las county electric 100-kilowatt grid-connected photovoltaic system.** V. V. Risser and P. Hutchinson (New Mexico Solar Energy Institute, Las Cruces, NM). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0067.* 7 p.

A 100-kilowatt flat-plate grid-connected photovoltaic system, funded by the Department of Energy, was installed in Lovington, New Mexico. The system is composed of two 50-kilowatt subfields, each with a dedicated power conditioning unit. A subfield contains 21 subarrays, 80 modules each. Oriented due south, the total panel area of 1,685 square meters may be adjusted manually to 10, 30, or 40 degrees from horizontal. System performance and weather information is collected and analyzed by New Mexico Solar Energy Institute. Performance data is checked daily and fault detection techniques are used if string current degradation is noted. The system has operated automatically since March 17, 1981. Reliability of prime system components has been high. This paper reviews results to date and examines system performance from a user's viewpoint. (Author)

A82-17765 # **Startup experience with a concentrating photovoltaic power system.** S. I. Kaplan (Oak Ridge National Laboratory, Oak Ridge, TN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0068.* 5 p. Contract No. W-7405-eng-26.

Physical features and startup characteristics of a 240 kW parabolic trough photovoltaic power system are described. The Mississippi County Community College array (Blytheville, AR) comprises 45 rows of linear parabolic troughs oriented N-S, which track E-W by means of a hydraulically driven actuator. The solar input is focussed onto 50/50 water-glycol cooled receiver bars on which Si solar cells are mounted. Nominal operating temperature for the cells is 50 C, with the heat transferred to the building heat supply in the winter. The output is routed through a power conditioning unit for inversion to 480 V ac power, for use by the school or, when the demand is exceeded, for direct transmission into the utility grid. Problems during startup have included misalignment, due to gravitational torquing and twisting, standoff insulation, and tracking during cloudy periods. Output has been 45% of design during the autumn of 1981. M.S.K.

A82-18025 **Electric utility modeling extensions to evaluate solar plants.** J. T. Day and M. J. Malone (Westinghouse Electric Corp., Pittsburgh, PA). *IEEE Transactions on Power Apparatus and Systems*, vol. PAS-101, Jan. 1982, p. 120-124; Discussion, p. 125, 126. 12 refs.

It is pointed out that solar concepts, such as solar thermal electric and photovoltaic conversion plants, which use direct sunshine, have operating characteristics that cannot be adequately handled with conventional generation planning models. The simulation methodology employed considers a separate detailed solar operation model which is interfaced with conventional utility generating planning models to determine the operating and reliability impact of solar plants on a utility system. Attention is also given to optimal utility expansion extensions. The operation of a 100 MWe central receiver solar-thermal power plant on a synthetic utility system representative of the southwest U.S. is considered. G.R.

A82-18222 * # **High performance solar Stirling system.** J. W. Stearns (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and R. Haglund (Advanco Corp., El Segundo, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2554.* 6 p. 10 refs. NASA-supported research.

A full-scale Dish-Stirling system experiment, at a power level of 25 kWe, has been tested during 1981 on the Test Bed Concentrator No. 2 at the Parabolic Dish Test Site, Edwards, CA. Test components, designed and developed primarily by industrial contractors for the Department of Energy, include an advanced Stirling engine driving an induction alternator, a directly-coupled solar receiver with a natural gas combustor for hybrid operation and a breadboard control system based on a programmable controller and standard utility substation components. The experiment demonstrated practicality of the solar Stirling application and high system performance into a utility grid. This paper describes the design and its functions, and the test results obtained. (Author)

A82-18223 * # **Configuration selection study for isolated loads using parabolic dish modules.** W. Revere, J. Bowyer, T. Fujita, and H. Awaya (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2549.* 11 p. 10 refs. Research sponsored by the U.S. Department of Energy and NASA.

A configuration tradeoff study has been conducted to determine optimum solar thermal parabolic dish power systems for isolated load applications. The specific application of an essentially constant power demand as required for MX missile shelters is treated. Supplying a continuous level of power with high reliability is shown to require a power system comprising modular parabolic dish power units where the heat engines of the modular power units can be driven by fossil fuels as well as solar-derived heat. Since constraints on reliability result in the provision of a power generating capability that exceeds the constant demand level, efficient utilization of the power system requires battery storage. Tradeoffs regarding the optimum size of storage are investigated as a function of the number of power modules and the cost of the fossil fuel which is used to meet the demand when insolation is unavailable and storage is depleted. (Author)

A82-18232 **Theoretical and numerical resolution of a mathematical model of the release of solar energy from storage (Résolution théorique et numérique d'un modèle mathématique de déstockage de l'énergie solaire).** H. Ghidouche, F. Lavainne, and N. Point (Paris XIII, Université, Villetaneuse, Seine-Saint-Denis, France). In: Numerical methods for engineering; Proceedings of the Second International Congress, Paris, France, December 1-5, 1980. Volume 1. Paris, Dunod, 1980, p. 369-382. In French.

Solutions of a mathematical model describing the recovery of solar energy stored as heat in a pebble bed are presented in the one- and two-dimensional cases. Fluid and pebble temperatures, and fluid pressure, velocity and density are obtained as functions of time and position for a pebble bed storage unit heated to a temperature of 70 C and releasing its heat to air at 20 C over the course of 6 months. The problem is treated numerically using different time scales for the pebbles and the fluid. In the one-dimensional case, the advancement of the energy release front is found to correspond to experimental observations. A.L.W.

A82-18287 * **Effects of low temperature periodic annealing on the deep-level defects in 200 keV proton irradiated AlGaAs-GaAs solar cells.** S. S. Li, T. T. Chiu (Florida, University, Gainesville, FL), and R. Y. Loo (Hughes Research Laboratories, Malibu, CA). *IEEE,*

U.S. Defense Nuclear Agency, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 18th, Seattle, WA, July 21-24, 1981.) IEEE Transactions on Nuclear Science, vol. NS-28, Dec. 1981, p. 4113-4118. 15 refs. Grant No. NsG-1425.

The GaAs solar cell has shown good potential for space applications. However, degradation in performance occurred when the cells were irradiated by high energy electrons and protons in the space environment. The considered investigation is concerned with the effect of periodic thermal annealing on the deep-level defects induced by the 200 keV protons in the AlGaAs-GaAs solar cells. Protons at a fluence of 10 to the 11th P/sq cm were used in the irradiation cycle, while annealing temperatures of 200 C (for 24 hours), 300 C (six hours), and 400 C (six hours) were employed. The most likely candidate for the E(c) -0.71 eV electron trap observed in the 200 keV proton irradiated samples may be due to GaAs antisite, while the observed E(v) +0.18 eV hole trap has been attributed to the gallium vacancy related defect. The obtained results show that periodic annealing in the considered case does not offer any advantages over the one time annealing process. G.R.

A82-18471 **Model based studies of some optical and electronic properties of narrow and wide gap materials.** N. M. Ravindra, K. S. Kumar, V. K. Srivastava (Roorkee, University, Roorkee, India), and R. P. Bhardwaj. *Infrared Physics*, vol. 21, Nov. 1981, p. 369-381. 28 refs. Research supported by the Council of Scientific and Industrial Research and University Grants Commission of India.

Studies are reported concerning the optical and electronic properties of narrow and wide gap materials in the groups IV, V, VI, III-V, II-VI, I-VII, IV-VI, and IV-IV, with emphasis on the high-frequency dielectric constant and its related properties. The relevance of this work to solar cells is discussed, and a comparative assessment of the models proposed by Penn (1962), Van Vechten (1969), Ureckenridge et al. (1974) and Grimes and Cowley (1975) is presented. It is found that, although all of the models give adequate estimates of the Penn gap, none of them are universally applicable. In addition, studies are presented of the temperature and pressure dependence of the Penn and energy gaps and the high frequency dielectric constant, followed by an evaluation of the electron-phonon contribution to the total temperature dependence of the energy gap and the refractive index. The inverse square law governing the variation of deformation potential with the lattice parameter is found to be valid for a large number of semiconductors. O.C.

A82-18645 # **Application of solar power satellites to India's energy needs - A macroengineering solution to a macroproblem.** J. P. Vajk (Science Applications, Inc., Pleasanton, CA). In: Macroengineering: The rich potential; Proceedings of the Third Symposium, San Francisco, CA, January 6, 1980. (A82-18643 06-99) New York, American Institute of Aeronautics and Astronautics, 1981, p. 97-109. 12 refs.

It is proposed that Solar Power Satellites (SPSs) be used as the primary energy source for the synthesis of methanol, which is easily transported, and may be derived from water and from carbon dioxide extracted from the air. In order to meet the household energy needs of India in this way at the turn of the century, 200 SPSs of 5 GW capacity each would be required. The construction and operation of the 2000 synthesis plants to which the SPS power would be transmitted by laser or microwave beam would (1) alleviate India's rural unemployment, (2) stimulate the development of economic infrastructures and a skilled labor force in rural areas, (3) reduce family energy expenditures, and (4) decrease pressures on the natural environment by providing a cheaper substitute for firewood and dried animal manures. O.C.

A82-18687 † **The universal plane method for calculating the dimensions of heliostats (Metod universal'noi ploskosti dlia rascheta gabaritov geliostata).** L. B. Perres and I. V. Baum (Akademiia Nauk Turkmenskoi SSR, Institut Solnechnoi Energii, Turkmen SSR). *Akademiia Nauk Turkmenskoi SSR, Izvestiia, Seriia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 5, 1981, p. 57-61. In Russian.

It is pointed out that heliostat dimensions are crucial in ensuring that sunlight is properly reflected during the day in solar furnaces and solar power stations. In determining these dimensions, allowance must be made for changes in the sun's position during the day, changes which depend on the latitude of the installation. To construct unique algorithms for calculating the dimensions, a procedure involving general concepts must be formulated and this formulation introduces a universal frame of reference. An example of this which has attracted considerable interest involves a flat round receiver that is parallel either to the horizontal plane or to the universal plane considered here. C.R.

A82-18688 † **Thermal deformation of concentrators in an antisymmetric temperature field (Termodeformatsii kontsentratorov v antisimmetrichnom temperaturnom pole).** R. Bairamov, V. M. Korolev, Iu. I. Machuev, A. Nazarov, E. V. Sokolov, and V. G. Fokin (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Akademiia Nauk Turkmenskoi SSR, Izvestiia, Seriia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 5, 1981, p. 67-72. 5 refs. In Russian.

Attention is given to skew-symmetric temperature deformations. It is noted that deformations of this type occur when the temperature of the middle surface of the mirror and when the temperature gradient of the thickness vary according to a certain law, which is given. Such a temperature distribution arises when the optical axis of the mirror does not coincide with the direction of the radiant heat flux. Expressions are given which make it possible to determine the deviations of points on the reflecting surface from the theoretical profile. The deformed surface obtained can be approximated by a paraboloid having parameters (focus distance and the direction of the optical axis) which differ from the original values. C.R.

A82-18816 **A simplified model of the thermohydraulic behaviour of a linear collector network for the conversion of the solar energy.** C. Bellecci, M. Camarca, M. Conti, L. La Rotonda, S. Natoli, G. Piccini, and R. Visentin (Calabria, Università, Cosenza, Italy). *Nuovo Cimento C, Serie 1*, vol. 4C, July-Aug. 1981, p. 385-396. 6 refs.

A model has been set up to describe the thermohydraulic behavior of a solar power plant in a quasi-steady-state approach; the simplifying assumptions have been proved to be correct. The model has been solved to determine the optimum sizes of the thermal accumulator. (Author)

N82-10276# Mid-American Solar Energy Complex, Minneapolis, Minn.
QUARTERLY REPORT OF SOLAR FEDERAL BUILDINGS PROGRAM IN THE MASEC REGION
Jun. 1981 20 p
(Contract DE-AC02-79CS-30150)
(DE81-027968; MASEC-R-81-059/1) Avail: NTIS HC A02/MF A01

Solar Federal Buildings Program (SFBP) projects within the 12-state MASEC region are listed. The states involved are Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The SFBP agencies projects are briefly described. DOE

N82-10490 Southern Methodist Univ., Dallas, Tex.
THIN-FILM POLYCRYSTALLINE CADMIUM TELLURIDE SOLAR CELLS AND LARGE-AREA POLYCRYSTALLINE SILICON SOLAR CELLS Ph.D. Thesis
Roshdy Abolazayem Abderrassoul 1981 139 p
Avail: Univ. Microfilms Order No. 8117882

Device quality polycrystalline films were deposited on a tungsten-coated graphite substrate by chemical vapor deposition. An in-situ indium layer was deposited prior to CdTe deposition to reduce the back resistance. Indium and iodine were used for n-type doping, and arsenic and phosphorus were used for p-type doping. The structural and electronic properties of the films were evaluated. Post-deposition heat treatment in a cadmium overpressure reduced the electrical resistivity by a factor of 2-3. Large-area purified metallurgical silicon substrates on graphite were prepared by unidirectional solidification. The moving-coil zone-melting technique was used. The pulverized metallurgicalsilicon was acid-treated and phosphoruspentoxide gettered prior to recrystallization, in order to reduce the content of harmful

metallic impurities, especially Al and Fe. A spectrophotometric technique was used to determine the iron content in the acid-treated silicon. Dissert. Abstr.

N82-10491 Southern Methodist Univ., Dallas, Tex.
THIN FILM PHOTOVOLTAIC DEVICES Ph.D. Thesis
Ching-Long Lin 1981 117 p
Avail: Univ. Microfilms Order No. 8117881

The deposition of a silicon film containing a p-n junction on a metallurgical silicon substrate was used for the preparation of thin-film silicon solar cells. The substrate was prepared by the unidirectional solidification of the purified metallurgical silicon on a graphite plate, and the silicon film was deposited by the thermal reduction of trichlorosilane with hydrogen containing appropriate dopants. Indium phosphide films were deposited on foreign substrates by the reaction of indium, hydrogen chloride, and phosphine. Their structural and electrical properties were studied. Schottky barriers prepared from indium phosphide films were found to have low rectification ratios, high dark currents, and poor photovoltaic response due to grain boundary effects. The effects of grain boundaries were partially reduced by thermal oxidation, ruthenium (III) treatment, and nitridation, thus improving the photovoltaic characteristics of thin-film indium phosphide solar cells. Dissert. Abstr.

N82-10496*# National Aeronautics and Space Administration. Pasadena Office, Calif.
SOLAR ENERGY MODULATOR Patent Application
Allan R. McDougal (JPL, California Inst. of Tech., Pasadena) and Robert R. Hale, inventors (to NASA) (JPL, California Inst. of Tech., Pasadena) Filed 17 Jul. 1981 14 p
(Contract NAS7-100)
(NASA-Case-NPO-15368-1; US-Patent-Appl-SN-284286) Avail: NTIS HC A02/MF A01 CSCL 10A

A module is described with a receiver having a solar energy acceptance opening and supported by a mounting ring along the optic axis of a parabolic mirror in coaxial alignment for receiving solar energy from the mirror, and a solar flux modulator plate for varying the quantity of solar energy flux received by the acceptance opening of the module. The modulator plate is characterized by an annular, plate-like body, the internal diameter of which is equal to or slightly greater than the diameter of the solar energy acceptance opening of the receiver. Slave cylinders are connected to the modulator plate for supporting the plate for axial displacement along the axis of the mirror thereby shading the opening with respect to solar energy flux reflected from the surface of the mirror to the solar energy acceptance opening. T.M.

N82-10500*# Optical Coating Lab., Inc., City of Industry, Calif. Photoelectronics Div.
SILICON SOLAR CELL PROCESS DEVELOPMENT, FABRICATION AND ANALYSIS Annual Report, 1 Jul. 1980 - 30 Jun. 1981
H. I. Yoo, P. A. Iles, and D. C. Leung 31 Jun. 1981 100 p refs Sponsored in part by DOE
(Contract JPL-955089)
(NASA-CR-163787; DOE/JPL-955089-81/12; JPL-9950-597) Avail: NTIS HC A05/MF A01 CSCL 10A

Solar cells were fabricated from EFG ribbons dendritic webs, cast ingots by heat exchanger method, and cast ingots by ubiquitous crystallization process. Baseline and other process variations were applied to fabricate solar cells. EFG ribbons grown in a carbon-containing gas atmosphere showed significant improvement in silicon quality. Baseline solar cells from dendritic webs of various runs indicated that the quality of the webs under investigation was not as good as the conventional CZ silicon, showing an average minority carrier diffusion length of about 60 um versus 120 um of CZ wafers. Detail evaluation of large cast ingots by HEM showed ingot reproducibility problems from run to run and uniformity problems of sheet quality within an ingot. Initial evaluation of the wafers prepared from the cast polycrystalline ingots by UCP suggested that the quality of the wafers from this process is considerably lower than the conventional CZ wafers. Overall performance was relatively uniform, except for a few cells which showed shunting problems caused by inclusions. T.M.

N82-10501*# Wyle Labs., Inc., Huntsville, Ala.
AN ANALYTICAL COMPARISON OF THE EFFICIENCY OF SOLAR THERMAL COLLECTOR ARRAYS WITH AND WITHOUT EXTERNAL MANIFOLDS Final Report
Sep. 1981 30 p
(Contract DEN8-000006)
(NASA-CR-161852) Avail: NTIS HC A03/MF A01 CSCL 10A

An analytical comparison of the efficiency of solar thermal collector arrays with and without external manifolds is reported. A FORTRAN computer program was written for the computation of the thermal performance of solar thermal collector arrays with and without external manifolds. Arrays constructed from two example solar thermal collectors are computated. Typical external manifold sizes and thermal insulations are presented graphically and are compared with the thermal performance of the collector alone. E.A.K.

N82-10502*# Wyle Labs., Inc., Huntsville, Ala.
PERFORMANCE EVALUATION OF THE SOLAR KINETICS T-700 LINE CONCENTRATING SOLAR COLLECTOR Final Report
Sep. 1981 49 p
(Contract DEN8-000006)
(NASA-CR-161856) Avail: NTIS HC A03/MF A01 CSCL 10A

A performance evaluation of the solar kinetics T-700 line concentrating solar collector is reported. Collector descriptions, summary, test conditions, test equipment, test requirements and procedures, and an analysis of the various tests performed are described. E.A.K.

N82-10504*# Wyle Labs., Inc., Huntsville, Ala.
EVALUATION OF ALL-DAY-EFFICIENCY FOR SELECTED FLAT PLATE AND EVACUATED TUBE COLLECTORS Final Contractor Report
Sep. 1981 158 p
(Contract DEN8-000006)
(NASA-CR-161866) Avail: NTIS HC A08/MF A01 CSCL 10A

An evaluation of all day efficiency for selected flat plate and evacuated tube collectors is presented. Computations are based on a modified version of the NBSIR 78-1305A procedure for all day efficiency. The ASHMET and NOAA data bases for solar insolation are discussed. Details of the algorithm used to convert total (global) horizontal radiation to the collector tilt plane of the selected sites are given along with tables and graphs which show the results of the tests performed during this evaluation. J.M.S.

N82-10507# Harvard Univ., Cambridge, Mass.
OPTIMIZATION OF TRANSPARENT ELECTRODE FOR SOLAR CELLS Technical Progress Report, 15 Dec. 1980 - 15 Jun. 1981
Roy G. Gordon 1981 5 p Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-77CH-00178)
(DE81-023350; SERI/PR-9318-1-T2) Avail: NTIS HC A02/MF A01

Fluorine-doped tin oxide films prepared from highly purified tetramethyl tin (TMT) were compared with films prepared under identical conditions using less pure TMT. No effects due to impurities were found. The use of thermocouples to measure the temperature of glass surfaces is unsatisfactory. The use of an infrared emission thermometer is recommended. DOE

N82-10509# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR PUBLIC SERVICE COMPANY OF NEW MEXICO (LOT 7) SINGLE FAMILY RESIDENCE, RIO RANCHO, NEW MEXICO
6 Aug. 1981 58 p
(Contracts DE-AB01-76CS-31020; HUD-H-2372)
(DE81-027853; SOLAR/1084-81/50) Avail: NTIS HC A04/MF A01

A solar space heating/domestic hot water system employing 150 square feet air flat plate collectors and 20,000 pounds of rock for storage is described. The collector, storage, energy to load, and auxiliary heat subsystems and five modes of operation are described. Auxiliary space heating is provided by an electric strip heater in the air ducts. The hot water system consists of an 80 gallon solar preheating tank which supplies a 40 gallon conventional tank. An electric heating element provides auxiliary heating in the preheat tank. DOE

N82-10810# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR COLORADO SUNWORKS: SINGLE FAMILY
1981 74 p
(Contracts DE-AS01-78CS-31020; HUD-H-2372)
(DE81-028054; SOLAR/1061-81/50) Avail: NTIS HC A04/MF A01

A passive solar energy system for both space heating and domestic hot water preheating is described. The passive space heating system consists of a drum wall and direct gain system. Heat losses are reduced by a Beadwall movable insulation. The vertically stacked drums near the south wall form a drumwall chimney where heated air rises through ceiling vents above the drums into an open plenum area between the roof and the ceiling of the rooms. Additional vents from this plenum on the north side of the house provide a path for the warm air into the room. Earth berms on the north, east, and west sides of the house, a one foot covering of earth on the roof, and an entry vestibule are used. Cooling is enhanced by night ventilation. The hot water system consists of two 30 gallon tanks painted black and positioned next to the south wall. Original cost estimates for provisioning and installation of the solar system are given.
DOE

N82-10811# Department of Housing and Urban Development, Washington, D. C.
SOLAR PROJECT DESCRIPTION FOR LIVING SYSTEMS SINGLE FAMILY RESIDENCE, DAVIS, CALIFORNIA
Oak Ridge, Tenn. DOE 31 Aug. 1981 75 p Prepared in cooperation with Boeing Co., Seattle
(Contract DE-AS01-76CS-31020)
(DE81-029743; SOLAR/1046-81/50) Avail: NTIS HC A04/MF A01

Two independent systems are described - a direct gain passive solar space heating system and an active domestic hot water preheating system. Large south-facing windows and a clerestory skylight permit direct winter Sun to enter the house. Solar energy thermal storage is provided by both water filled tubes and the concrete slab floor. Movable shutters and insulating curtains provide capability to reduce night heat losses. Summer overheat protection is provided by roof overhangs and by natural ventilation. The collector, storage, heating load, and auxiliary loads subsystems and modes of operation are described for both systems. The house is instrumented for thermal performance evaluation. Original cost estimates for provisioning and installation of the solar system are given.
DOE

N82-10812# Midwest Research Inst., Kansas City, Mo. Solar Energy Research Inst.
ENERGY END-USE REQUIREMENTS IN MANUFACTURING, VOLUME 1
Dilip R. Limaye (Synergic Resources Corp.), Steven Isser (Synergic Resources Corp.), Roy Beatty (Synergic Resources Corp.), Glenn Colville (Synergic Resources Corp.), Karen Lang (Synergic Resources Corp.), and Frank Krawiec Jul. 1981 233 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-028975; SERI/TR-733-790R-Vol-1) Avail: NTIS HC A11/MF A01

A review and evaluation of existing industrial energy data bases were undertaken to assess their potential for supporting SERI research to analyze technical and economic feasibility of solar technologies, and to establish multilayer R and D programs for: solar thermal industrial electric power systems and solar IPH systems. In the review of existing industrial energy data bases, the level of detail, disaggregation, and primary sources of information were examined. The focus was on fuels and electric energy used for heat and power purchased by the manufacturing subsector and listed by 2-, 3-, and 4-digit SIC, primary fuel, and end use.
DOE

N82-10813# Sandia Labs., Albuquerque, N. Mex.
FREQUENCY RESPONSE ANALYSIS OF FLUID CONTROL SYSTEMS FOR PARABOLIC-TROUGH SOLAR COLLECTORS
R. Schindwolf Jul. 1981 29 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029293; SAND-80-0385) Avail: NTIS HC A03/MF A01

A linearized steady-state frequency response is derived for parabolic-trough collectors and for connecting piping that can be used in standard gain-phase analyses to evaluate system stability and closed-loop frequency response. The frequency-response characteristics of a typical collector string and piping are used in a gain-phase analysis to get some insight into the effect on system stability of various system parameters such as controller gain, sensor and controller-time constants, and sensor location.
DOE

N82-10815# Science Applications, Inc., McLean, Va. Electro-Optics Technology Div.
TECHNICAL AND ECONOMIC ASSESSMENT OF SOLAR THERMOPHOTOVOLTAIC CONVERSION Final Report, Jul. 1981
W. Koechner, H. R. Verdun, and N. C. Wyeth Jul. 1981 190 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1415-1)
(DE81-903762; EPRI-AP-1940) Avail: NTIS HC A09/MF A01

The solar thermophotovoltaic (STPV) conversion concept is aimed at large-scale electric utility applications. After consideration of several options, a conceptual system arrangement was chosen an analyzed to provide calculations for STPV system configuration, size, performance, and cost. Baseline designs were selected fo the optical and converter subsystems, and a detailed analysis of the performance of these subsystems was made using mathematical models an computer codes. The various subsystems operating parameters were related to overall sytem performance and cost, and a minimum cost/power output point was found for the conceptual system.
DOE

N82-10816# Vedo, Inc., Camarillo, Calif.
ECONOMIC ANALYSIS OF THE UNIFIED HELIOSTAT ARRAY
7 Nov. 1980 395 p refs
(Contract DE-AC03-80SF-10802)
(DE81-026898; DOE/SF-10802/T4;
VEDA-43905-80U/P0089) Avail: NTIS HC A17/MF A01

The array (UHA) is comprised of conventional two-axis heliostats mounted on a terraced south-facing wall of a single structure. The arrangement of heliostats on the array is chosen to eliminate or control the degree of inter-heliostat shading and blocking. The UHA was investigated as to cost and optical performance. Two heliostats, the Veda Industrial Heliostat (VIH) and the Repowering Helistat were investigated in conjunction with the UHA. The UHA is found to be a viable candidate for solar thermal central receiver applications. The UHA-VIH combination was shown to provide very high flux densities and to be suitable for high temperature applications in the 1000 K to 2000 K range. These temperatures were shown to be achieve even with very small (1 MWt) collector fields.
DOE

N82-10819# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PERFORMANCE OF TERRESTRIAL PHOTOVOLTAIC MODULES AT MIT LINCOLN LABORATORY EXPERIMENTAL PHOTOVOLTAIC SYSTEMS
S. E. Forman 30 Apr. 1981 19 p refs
(Contract DE-AC02-78ET-20279)
(DE81-029995; DOE/ET-20279/140) Avail: NTIS HC A02/MF A01

Through a program of periodic surveillance, measurements and inspections, over 250 electrically failed modules were located, removed and analyzed during a four-year period. The principal causes of failure were: cells cracked due to weathering or internal module stresses; failed solder joints; interconnects not soldered to rear sides of cells at assembly; cells or interconnects electrically shorted to metallic substrates; and broken or split interconnects. Details and photographs of many of the different typs of failures are presented. In addition, some of the analysis techniques used to locate the failures are described.
DOE

N82-10821# Chicago Univ., Ill. Enrico Fermi Inst.
INTEGRATED FUNCTION NONIMAGING CONCENTRATING COLLECTOR TUBES FOR SOLAR THERMAL ENERGY Technical Progress Report
Roland Winston and Joseph J. OGallagher 25 Aug. 1981 21 p refs
(Contract DE-AC02-80ER-10658)
(DE81-029677; DOE/ER-10658/2) Avail: NTIS HC A02/MF A01

A substantial improvement in optical efficiency over contemporary external reflector evacuated tube collectors was achieved by integrating the reflector surface into the outer glass envelope. The design, fabrication and preliminary test results are described

for a prototype collector based on this concept. Efficiencies above 40% up to nearly 300 C may be achieved. DOE

N82-10534# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
STANDARDS APPLICATION AND DEVELOPMENT PLAN FOR SOLAR THERMAL TECHNOLOGIES
H. R. W. Cobb Jul. 1981 218 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-030310; SERI/TR-742-888) Avail: NTIS
HC A10/MF A01

Functional and standards matrices, developed from input from ST users and from the industry that will be continually reviewed and updated as commercial aspects develop are presented. The matrices highlight codes, standards, test methods, functions and definitions that need to be developed. They will be submitted through ANSI for development by national consensus bodies. A contingency action is proposed for standards development if specific input is lacking at the committee level or if early development of a standard would hasten commercialization or gain needed jurisdictional acceptance. T.M.

N82-10537# Los Alamos Scientific Lab., N. Mex.
STATE OF THE ART IN PASSIVE SOLAR HEATING
J. Douglas Balcomb 1981 4 p Presented at the Passive and Hybrid Solar Energy Program Update Meeting, Washington, D.C., 9-12 Aug. 1981
(Contract W-7405-eng-36)
(LA-UR-81-2185; CONF-810832-1) Avail: NTIS
HC A02/MF A01

The state of the art is outlined according to four major categories: passive, solar practice, evaluation, design, and products and materials. Needed future research activities and point industry/government activities are listed. DOE

N82-10538# Los Alamos Scientific Lab., N. Mex.
LOS ALAMOS NATIONAL LABORATORY PASSIVE SOLAR PROGRAM
Donald A. Neeper 1981 12 p refs Presented at the Passive and Hybrid Solar Energy Program Update Meeting, Washington, D.C., 9-12 Aug. 1981
(Contract W-7405-eng-36)
(DE81-028778; LA-UR-81-2162; CONF-810832-2) Avail: NTIS HC A02/MF A01

Progress in passive solar tasks performed for FY-81 is documented. Twenty-eight configurations of sunspaces were studied using the solar load ratio method of predicting performance, the configuration showing best performance is discussed. The minimum level of insulation needed to generate convective flow in the thermosphon test rig is noted and measured. Information is also included on test room performance, off speak auxiliary electric heating for a passive home, free convection experiment, monitored building, and technical support to the US Department of Energy. DOE

N82-10539# Midwest Research Inst., Kansas City, Mo. Solar Energy Research Inst.
INVESTIGATION OF PHOTOVOLTAIC MECHANISMS IN POLYCRYSTALLINE THIN-FILM SOLAR CELLS Quarterly Report, 1 Aug. - 31 Oct. 1980
T. A. Temofonte 3 Apr. 1981 18 p refs
(Contract DE-AC02-77CH-00178)
(DE81-027272; SERI/PR-9233-1-T1; QR-1) Avail: NTIS
HC A02/MF A01

Initial efforts focused on exploring the role of atomic hydrogen on silicon surfaces. The atomic hydrogen was generated using an inductively coupled plasma. Comparisons using Auger sputter profiling were made of hydrogenated silicon surfaces, deliberately oxidized silicon surfaces and silicon surfaces having a native oxide. The auger spectrum of a hydrogenated silicon surface is initially qualitatively similar to that for an oxidized surface. Distinct differences emerge as a function of sputtering depth, viz., the ratio of free silicon to bonded silicon decreases first before finally decreasing. This implies a significantly different surface composition for hydrogenated silicon compared to oxidized silicon. DOE

N82-10541# Sandia Labs., Albuquerque, N. Mex.
SOLAR ENERGY SYSTEM DESIGN: A SIMPLE METHOD FOR SIZING THE COLLECTOR FIELD AND THERMAL STORAGE
Ralph R. Peters Jul. 1981 81 p refs
(Contract DE-AC04-76DP-00789)
(DE81-028852; SAND-81-1841) Avail: NTIS
HC A05/MF A01

The Zero Marginal Cost (ZMC) technique to enable quick, accurate designs of parabolic trough solar energy systems was developed. The ZMC technique is discussed and it is shown that systems designed with this technique compare quite favorably with those designed using expensive computer codes. DOE

N82-10542# SRI International Corp., Menlo Park, Calif.
CONCEPTUAL DESIGN OF A GLASS-REINFORCED CONCRETE SOLAR COLLECTOR
Arthur J. Siemmons, Dale W. Ploeger, and Ron Lundgren (Sandia Labs., Albuquerque, N. Mex.) Jul. 1981 51 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029280; SAND-81-7011) Avail: NTIS
HC A04/MF A01

An investigation of the properties and characteristics of glassfiber-reinforced concrete (GRC) was made to determine its suitability as a reflector substrate and structure for heliostats and solar collectors. The material properties and characteristics of GRC were established by tests on small flat panels. A conceptual design of a 2-m x 6-m parabolic trough solar collector module and a preliminary production-cost analysis were also completed. DOE

N82-10543# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC-SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 1: FOR LOVINGTON SQUARE SHOPPING CENTER SITE, LOVINGTON, NEW MEXICO
Jul. 1981 18 p Prepared for Sandia Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE81-028971; SAND-81-7085/1) Avail: NTIS
HC A02/MF A01

A 100 kwp photovoltaic flat panel system is planned for application in a shopping center to assess problems associated with utility tie-in and to provide utility experience with a photovoltaic system. The project is briefly outlined, and the participants are listed. Relevant weather data and reference operating conditions are given and four operational modes are described. System specifications are given and the solar array, control, protection, and data acquisition and instrumentation subsystems are described. DOE

N82-10547# Mid-American Solar Energy Complex, Minneapolis, Minn.
SUMMARY OF PASSIVE-SOLAR-RETROFIT WORKSHOPS
Jun. 1981 12 p
(Contract DE-AC02-79CS-30150)
(DE81-028146; MASEC-CF-81-028) Avail: NTIS
HC A02/MF A01

Efforts are described to provide training in the latest passive solar retrofit techniques to a wide sector of residential design and construction professionals. Three 20-hour passive solar single-family retrofit workshops were attended by 116 residential construction-related participants. Each of the three workshops is described. The workshop topics and workbook were evaluated by 65 participants, and suggestions were made for improvement. DOE

N82-10558# Lincoln Lab., Mass. Inst. of Tech., Lexington.
TESTING AND EVALUATION OF A SOLAR PHOTOVOLTAIC FLYWHEEL ENERGY STORAGE SYSTEM
Philip O. Jarvinen, Bronwyn L. Prench, R. Duncan Hay, and Neil F. Rasmussen (American Power Conversion, Burlington, Mass.) 1981 6 p Presented at the IECEC Conf., Atlanta, 9-14 Aug. 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/130; CONF-810812-4) Avail: NTIS
HC A02/MF A01

Measurements made on a 1/10 scale, magnetically levitated, residential solar photovoltaic (PV) flywheel energy storage system which acts as a complete interface between a solar PV array and an ac load are reported. The overall in/out electrical storage efficiency of the flywheel unit was measured along with the power transfer efficiencies of individual components and the system spin down tar losses. An overall storage efficiency of 82 percent was measured for the flywheel storage system when operated in a utility interactive mode. DOE

N82-10663# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
APPLICATION OF SOLAR THERMAL ENERGY TO BUILDINGS AND INDUSTRY
Charles F. Kutscher May 1981 32 p refs Presented at the Energy and the Man-Built Environment Conf., Vail, Colo., 3-5 Aug. 1981; sponsored by Am. Soc. of Civil Eng.
(Contract DE-AC02-77CH-00178)
(SERI/TP-641-1222; CONF-810808-6) Avail: NTIS HC A03/MF A01

Flat plate collectors and evacuated tube collectors are described, as are parabolic troughs, Fresnel lenses, and compound parabolic concentrators. Use of solar energy for domestic hot water and for space heating and cooling are discussed. Some useful references and methods of system design and sizing are given. This includes mention of the importance of economic analysis. The suitability of solar energy for industrial use is discussed, and solar ponds, point-focus receivers and central receivers are briefly described. The use of solar energy for process hot water, drying and dehydration, and process steam was examined, industrial process heat field tests by the Department of Energy are discussed, and a solar total energy system in Shenandoah, GA is briefly described. DOE

N82-10568# Institute of Gas Technology, Chicago, Ill.
ELECTROCHEMICAL PHOTOVOLTAIC CELLS Quarterly Technical Progress Report, 1 Nov. 1980 - 31 Jan. 1981
Peter G. P. Ang, Anthony J. Tiller, Anthony A. Rossignuolo, and Anthony F. Sammells Apr. 1981 24 p ref Sponsored in cooperation with Midwest Research Inst.
(Contract EG-77-C-01-4042)
(DE81-769704; SERI/PR-9175-1-T3) Avail: NTIS HC A02/MF A01

The photoelectrochemical properties of p-Si, p-InP, p-MoS2, and n-CdSe semiconductors are presented. A number of redox storage systems are discussed. Characteristics of single crystal systems and of surface treatments are investigated. Long term testing was performed with polycrystalline CdSe and with p-InP single crystal in electrochemical cells. The quality and long term stability of various electrodes, electrolytes, and separator materials are studied. DOE

N82-10569# Pennsylvania State Univ., University Park. Materials Research Lab.
CONTROLLED CADMIUM TELLURIDE THIN FILMS FOR SOLAR-CELL APPLICATIONS Quarterly Report, 1 Dec. 1980 - 1 Feb. 1981
M. B. Das and S. W. Krishnaswamy 15 May 1981 14 p refs
(Contract DE-AC02-77CH-00178)
(DE81-023275; SERI/PR-9131-1-T3; QR-3) Avail: NTIS HC A02/MF A01

Indium doped CdTe films cadmium vacancies occur which cause the presence of deep level acceptor states in the material are discussed. By sputtering at a cadmium overpressure, it was possible to compensate for these vacancies and improve the device quality. Extensive temperature dependent measurements of dark and illuminated I/V characteristics of gold metalized Schottky barrier diodes based on these improved and reproducible films were made. Characteristics showing I/sub sc/ and V/sub oc/ at different temperatures and different illumination level are presented. DOE

N82-10570# Sandia Labs., Albuquerque, N. Mex. Photovoltaic Projects Div.
SOLAR PHOTOVOLTAIC SYSTEM ENGINEERING PERSPECTIVES
Gary J. Jones 1981 7 p refs Presented at the Energy in Man-Built Environ.: The Next Decade Spec. Conf., Vail, Colo., 3 Aug. 1981
(Contract DE-AC04-76DP-00789)
(DE81-023179; SAND-81-1164C; CONF-810808-7) Avail: NTIS HC A02/MF A01

The activities of the national photovoltaic program which aid the photovoltaic system background information are presented and major issues are highlighted. DOE

N82-10571# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.
TECHNOLOGICAL ACTIVITIES FOR HIGH PERFORMANCE RECEIVERS Final Report
Guenther Schmidt, Erich Kimer, and Helmut Zewen Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 86 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-133; MBB-UR-39979-79; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18.05

Preliminary studies were carried out on the optimization of the energy transfer efficiency from the incident solar radiation into the heat transfer medium of solar thermal plants by designing high performance receivers. The transfer efficiency has a direct impact on the overall plant efficiency and the size of the cost effective collector field. Two main lines were followed, closed Renkine cycles with organic heat transfer media at temperatures between 350 and 400 C; and gas turbine cycles at temperatures from 800 to 900 C. A test receiver cooled by organic media was built and its thermal and mechanical resistance as well as the behavior of different heat transfer media with respect to thermal efficiency and stability were analyzed. Industrial application appears feasible. Author (ESA)

N82-10577# Department of Agriculture, Washington, D.C.
THE YOUNG SOLAR COLLECTOR: AN EVALUATION OF ITS MULTIPLE FARM USES
Walter G. Heid, Jr. May 1981 21 p ref
(PB81-214132; AER-466) Avail: NTIS HC A02/MF A01 CSCL 13A

The features of the Young collector and reports on its physical and economic performance were studied. The collector is portable and tiltable, with a flexible airflow system. It is found that it satisfactorily dries grain, provides home heating, and saves energy. The homemade, low cost Young flat plate solar collector for multiple uses on the farm was designed by a farm couple and the small farm energy project. GRA

N82-10863# Sandia Labs., Albuquerque, N. Mex. Photometrics and Optical Development Div.
AUTOMATED FRESNEL LENS TESTER SYSTEM
Gary S. Phipps Jul. 1981 71 p
(Contract DE-AC04-76DP-00789)
(DE81-029483; SAND-81-1187) Avail: NTIS HC A04/MF A01

An automated data collection system controlled by a desktop computer for testing Fresnel concentrators (lenses) intended for solar energy applications was developed. The system maps the two dimensional irradiance pattern formed in a plane parallel to the lens, whereas the lens and detector assembly track the Sun. A point detector silicon diode measures the irradiance at each point of an operator defined rectilinear grid of data positions. Comparison with a second detector measuring solar insolation levels results in solar concentration ratios over the image plane. Summation of image plane energies allows calculation of lens efficiencies for various solar cell sizes. DOE

N82-10952# Argonne National Lab., Ill.
SOLAR DATA BASE MANAGEMENT SYSTEM
I. Singh (Mohawk Coll., Hamilton, Ont.), R. M. Wolosewicz, H. Singh, and P. S. Chopra 1980 8 p refs Presented at the ASME Century 2 Emerging Technol. Conf., San Francisco, 12-15 Aug. 1980
(Contract W-31-109-eng-38)
(DE81-023122; CONF-800804-40) Avail: NTIS HC A02/MF A01

The data base management system established to handle the reliability and materials assessment data generated by over 100 solar heating and cooling systems was assessed. The planning, the design, and some of the software used to handle data processing and reduction requirements are described. DOE

N82-11209*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FRACTURE MECHANICS OF CELLULAR GLASS
J. G. Zwissler and M. A. Adams 1 Feb. 1981 53 p refs
(Contracts NAS7-100; DE-AI01-81ET-20307)
(NASA-CR-164959; JPL-Pub-81-16) Avail: NTIS HC A04/MF A01 CSCL 11A

The fracture mechanics of cellular glasses (for the structural substrate of mirrored glass for solr concentrator reflecting panels) are discussed. Commercial and developmental cellular glasses were tested and analyzed using standard testing techniques and

models developed from linear fracture mechanics. Two models describing the fracture behavior of these materials were developed. Slow crack growth behavior in cellular glass was found to be more complex than that encountered in dense glasses or ceramics. The crack velocity was found to be strongly dependent upon water vapor transport to the tip of the moving crack. The existence of a static fatigue limit was not conclusively established, however, it is speculated that slow crack growth behavior in Region 1 may be slower, by orders of magnitude, than that found in dense glasses. B.W.

N82-11247# California Univ., Livermore. Lawrence Livermore Lab.
SOLAR COAL-GASIFICATION REACTOR FOR HYDROCARBON-FREE SYNTHESIS GAS
W. R. Aiman Jun. 1981 10 p Presented at the STTF Users Assoc. Ann. Meeting, Pasadena, Calif., 23 Apr. 1981
(Contract W-7405-eng-48)
(DE81-026600; UCRL-86260; CONF-810469-3) Avail: NTIS HC A02/MF A01

The products from a coal gasification process are discussed. In synthesis gas production, the end product is a high Btu gas composed of methane and higher hydrocarbons. Furthermore, the liquid hydrocarbons can be even more valuable as feedstocks for other processes. In other applications such as methanol production, the hydrocarbon content of the synthesis gas is a non-reactive diluent that must be bled away from the product synthesis area to keep its concentration from building up. In addition to the above benefits, this reactor requires substantially less steam in the coal gasification process. The reactor is able to produce hydrocarbon-free synthesis gas because it withdraws the pyrolysis gases from the reactor as they are formed and reinjects them above the char gasification zone where they are steam reformed into CO, CO2, and H2. Since almost all of the hydrocarbons released in coal gasification come off with the pyrolysis gases, the reactor will produce nearly hydrocarbon-free gas. DOE

N82-11316# Mid-American Solar Energy Complex, Bloomington, Minn.
MASEC SOLAR 80 HOME DESIGNS
1980 19 p
(DE81-028344; MASEC-PA-80-007) Avail: NTIS HC A02/MF A01

Plans of passive solar homes designed by ten teams from various sections of the mid-American region are presented. The energy efficient designs use up to 80% less fossil fuel energy for heating than those built to conventional construction standards. Energy conserving and passive design techniques are discussed. The design features of the ten (RidgeWay, ClaireMont, SolarWay, KirkWood, SunSource, ParkLand, CedarWood, SunRise, SunCrest, and WaterFord) homes are presented. DOE

N82-11325# Booz-Allen and Hamilton, Inc., Bethesda, Md. Energy and Environment Div.
USER NEEDS FOR SOLAR DECISION-MAKING TOOLS: THE HOMEBUILDING INDUSTRY Final Report
Min Kantrowitz, John Kurtz, and Kimball Hart 1981 131 p refs Prepared in cooperation with Midwest Research Inst., Golden, Colo.
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-027293; SERI/TR-98252-1b) Avail: NTIS HC A07/MF A01

The need for decision tools and design tools to be used by decision makers considering using solar energy in the single-family residential construction sector was studied. Three builder groups were found based upon decision making patterns relative to innovation and a five-step decision process. Eleven existing design tools were reviewed against identified user needs. The principal conclusions are that decision tools are largely lacking and design tools do not easily fit user needs. Recommendations for further study are made. DOE

N82-11407# Science Applications, Inc., McLean, Va. Solar Technology Div.
PARAMETRIC SENSITIVITY STUDY FOR SOLAR-ASSISTED HEAT-PUMP SYSTEMS Final Report
N. M. White and J. H. Morehouse Jul. 1981 110 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contracts DE-AC02-77CH-0017; EG-77-C-01-4042)
(DE81-030309; SERI/TR-98288-1) Avail: NTIS HC A06/MF A01

The engineering and economic parameters affecting life-cycle costs for solar-assisted heat pump systems are investigted. The change in energy usage resulting from each engineering parameter varied was developed from computer simulations, and is compared with results from a stand-alone heat pump system. Three geographical locations are considered: Washington, D.C., Fort Worth, TX, and Madison, WI. Results indicate that most engineering changes to the systems studied do not provide significant energy savings. The most promising parameters to ary are the solar collector parameters tau (-) and U/sub L/ the heat pump capacity at design point, and the minimum utilizable evaporator temperature. Costs associated with each change are estimated, and life-cycle costs computed for both engineering parameters and economic variations in interest rate, discount rate, tax credits, fuel unit costs and fuel inflation rates. Results indicate that none of the feasibile engineering changes for the system configuration studied will make these systems economically competitive with the stand-alone heat pump without a considerable tax credit. DOE

N82-11413# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
DOE SOLAR-ASSISTED HEAT-PUMP PROGRAM: ITS EVOLUTION AND ITS POTENTIAL
J. W. Andrews 1981 5 p refs Presented at the Active Solar Contractors' Rev. Meeting, Washington, D.C. Sep. 1981
(Contract DE-AC02-76CH-00016)
(DE81-026055; BNL-29677; CONF-810912-10) Avail: NTIS HC A02/MF A01

Progress in the solar assisted heat pump program is described in terms of the progressive modification of original assumptions on the basis of accumulating experience. The ways in which these modifications led to enhanced system potential are explained. A major impetus for progress is the assimilation and reconciliation of divergent systems analysis results. Technical accomplishments in the program are described, and needed future activities are listed. DOE

N82-11544*# Teledyne Brown Engineering, Huntsville, Ala. Engineering Services Div.
INVESTIGATION OF DIRECT SOLAR-TO-MICROWAVE ENERGY CONVERSION TECHNIQUES Final Report
N. E. Chatterton, T. K. Mookherji, and P. K. Wunsch Jan. 1978 107 p refs
(Contract NAS8-32643)
(NASA-CR-161883; ESD-78-MSFC-2174) Avail: NTIS HC A06/MF A01 CSCL 10A

Identification of alternative methods of producing microwave energy from solar radiation for purposes of directing power to the Earth from space is investigated. Specifically, methods of conversion of optical radiation into microwave radiation by the most direct means are investigated. Approaches based on demonstrated device functioning and basic phenomenologies are developed. There is no system concept developed, that is competitive with current baseline concepts. The most direct methods of conversion appear to require an initial step of production of coherent laser radiation. Other methods generally require production of electron streams for use in solid-state or cavity-oscillator systems. Further development is suggested to be worthwhile for suggested devices and on concepts utilizing a free-electron stream for the intraspace station power transport mechanism. S.L.

N82-11548*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE EFFECTS OF IMPURITIES ON THE PERFORMANCE OF SILICON SOLAR CELLS
K. A. Yamakawa 1 Sep. 1981 75 p refs
(Contracts NAS7-100; EX-76-A-29-1012; DE-AI01-76ET-20356)
(NASA-CR-164945; JPL-Pub-81-76; DOE/JPL-1012-57) Avail: NTIS HC A04/MF A01 CSCL 10A

The major factors that determine the tolerable concentrations of impurities in silicon feedstock for solar cells used in power generation are discussed in this report. It is concluded that a solar-grade silicon can be defined only for a specific manufacturing process. It is also concluded that it is the electrical effects, efficiency and resistivity, that are dominant in determining tolerable

concentrations of impurities in the silicon feedstock. Crystal growth effects may become important when faster growth rates and larger crystal diameters are developed and used. Author

N82-11548*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
IRRIGATION MARKET FOR SOLAR THERMAL PARABOLIC DISH SYSTEMS
Hamid Habib-agahi and Sue Campbell Jones 1 Sep. 1981 40 p refs
(Contracts NAS7-100; DE-AT04-81AL-16228)
(NASA-CR-164955; JPL-Pub-81-85; DOE/JPL-1060-48) Avail: NTIS HC A03/MF A01 CSCL 10A

The potential size of the onfarm-pumped irrigation market for solar thermal parabolic dish systems in seven high-insolation states is estimated. The study is restricted to the displacement of three specific fuels: gasoline, diesel and natural gas. The model was developed to estimate the optimal number of parabolic dish modules per farm based on the minimum cost mix of conventional and solar thermal energy required to meet irrigation needs. The study concludes that the potential market size for onfarm-pumped irrigation applications ranges from 101,000 modules when a 14 percent real discount rate is assumed to 220,000 modules when the real discount rate drops to 8 percent. Arizona, Kansas, Nebraska, New Mexico and Texas account for 98 percent of the total demand for this application, with the natural gas replacement market accounting for the largest segment (71 percent) of the total market. Author

N82-11550*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SECONDARY AND COMPOUND CONCENTRATORS FOR PARABOLIC DISH SOLAR THERMAL POWER SYSTEMS
L. D. Jaffe and P. T. Poon 15 Apr. 1981 47 p refs Sponsored in part by DOE
(Contract NAS7-100)
(NASA-CR-164960; JPL-Pub-81-27; DOE/JPL-1060-43) Avail: NTIS HC A03/MF A01 CSCL 10A

A secondary optical element may be added to a parabolic dish solar concentrator to increase the geometric concentration ratio attainable at a given intercept factor. This secondary may be a Fresnel lens or a mirror, such as a compound elliptic concentrator or a hyperbolic trumpet. At a fixed intecept factor, higher overall geometric concentration may be obtainable with a long focal length primary and a suitable secondary matched to it. Use of a secondary to increase the geometric concentration ratio is more likely to e worthwhile if the receiver temperature is high and if errors in the primary are large. Folding the optical path with a secondary may reduce cost by locating the receiver and power conversion equipment closer to the ground and by eliminating the heavy structure needed to support this equipment at the primary focus. Promising folded-path configurations inclue the Ritchey-Chretien and perhaps some three element geometries. Folding the optical path may be most useful in systems that provide process heat. Author

N82-11551*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR CELL DEVELOPMENT FOR THE POWER EXTENSION PACKAGE
Cosmo R. Baraona and James L. Cioni (NASA, Johnson Space Center) 1981 8 p refs Presented at the 16th Intersoc. Energy Conversion Conf., Atlanta, 9-14 Aug. 1981
(NASA-TM-82686; E-922) Avail: NTIS HC A02/MF A01 CSCL 10A

The PEP is a 32 kilowatt flexible substrate, retrievable, solar array system for use on the Space Shuttle. Solar cell costs will be reduced by increasing cell area and simplifying cell and coverglass fabrication processes and specifications. The cost goal is to produce cells below $30 per watt. Two and ten ohm-cm silicon cells were investigated. In phase I of the cell development program a few thousand candidate cells will be produced and evaluated for utility and quality. In phase II a large number of cells will be fabricated to verify production readiness and cell yields and costs. This schedule is compatible with PEP initial operational capability in 1984. Approximately 140,000 large area (5.9 x 5.9 cm) cells will be required for two PEP solar arrays. The status of the cell development and testing, including a radiation damage test and side-by-side comparison of candidate cell types with pre- and post-irradiation airplane calibration of outer space short-circuit current, is reported. T.M.

N82-11554# Arkansas Univ., Fayetteville.
MISSISSIPPI COUNTY COMMUNITY COLLEGE SOLAR PHOTOVOLTAIC PROJECT Final Report
F. K. Deaver, M. M. Johnson, Tom Pugh, Ray Snowden, W. D. Turner, J. D. Wall, J. G. Williams, and J. R. Yeargan Nov. 1980 256 p refs
(Contract DE-FG05-77CS-20347; Grant EG-77-G-05-5565)
(DE81-030669; DOE/ET-20347/T1) Avail: NTIS HC A12/MF A01

A weather station was maintained from April 1978 to April 1980. Daily totals of direct normal and global insolation are given, and an hour-by-hour printout of direct normal, global, and diffuse solar radiation for the entire two year period is included. A number of studies were conducted, including daylighting, energy conservation and management, design tradeoffs, and landscaping. The collector selection process included the writing of specifications, providing design data, reviewing the various collector designs, inspecting potential vendor facilities, monitoring on-site tests, and the final selection. A simulation was made of the entire system, including both an electrical and thermal simulation of the photovoltaic array and a thermal simulation of the various buildings. Example printouts of the simulations are included. DOE

N82-11557# RCA Labs., Princeton, N. J.
AMORPHOUS BORON-SILICON-HYDROGEN ALLOYS FOR THIN-FILM HETEROJUNCTION SOLAR CELLS Quarterly Technical Progress Report, 1 Sep. - 30 Nov. 1980
A. R. Moore, D. E. Carlson, and R. W. Smith May 1981 18 p refs
(Contract DE-AC02-77CH-00178)
(DE81-027234; SERI/PR-0-9010-2; QTPR-2) Avail: NTIS HC A02/MF A01

The conductivity of a-B:Si:H films increases with substrate temperature and annealing temperature for temperatures up to 5000 C (highest investigated). However, increasing the conductivity causes the optical gap to decrease. Preliminary results on a-B:Si:H/a-Si:H heterojunction devices are not encouraging as interface states appear to limit the conversion efficiency to approx. 1.5%. DOE

N82-11558# RCA Labs., Princeton, N. J.
AMORPHOUS BORON-SILICON-HYDROGEN ALLOYS FOR THIN-FILM HETEROJUNCTION SOLAR CELLS Quarterly Technical Progress Report, 1 Dec. 1980 - 28 Feb. 1981
A. R. Moore, D. E. Carlson, and R. W. Smith Jun. 1981 18 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-77CH-00178)
(DE81-027254; SERI/PR-0-9010-3; QTPR-3) Avail: NTIS HC A02/MF A01

Amorphous boron-silicon-hydrogn (a-B:Si:H) alloys were used to make heterojunction contacts to hydrogenated amorphous silicon (a-Si:H) films. The performance of a-B:Si:H/a-Si:H heterojunction cells are limited mainly by a large density of interface states. Another p-type, wide bandgap material, microcrystalline silicon-carbon-hydrogen (M-Si:C:H) was investigated. Three techniques are explored for production of m-Si:C:H films: glow discharge deposition, thermal annealing of a-Si:C:H films, and laser annealing of a-Si:C:H: films. DOE

N82-11560# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: FOREST CITY DILLON, WASHINGTON, D.C., JANUARY 1980 - DECEMBER 1980
D. W. Missal 1980 82 p refs
(Contract DE-AC02-79CS-30027)
(DE81-028174; SOLAR/1041-81/14) Avail: NTIS HC A05/MF A01

An active solar energy system consisting of single glazed flat plate collectors, 3200 gallons of storage liquid, and an auxiliary oil fired boiler, was designed to supply 59% of the hot water demand for a high rise apartment building. The annual solar fraction predicted by the f chart simulation was 37%, and the solar fraction measured was 32%. Other measures of performance, including solar system coefficient of performance, are given. The performance of the collector, storage, and domestic hot water subsystems is discussed. DOE

N82-11561# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div

SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: MONTECITO PINES, SANTA ROSA, CALIFORNIA, NOVEMBER 1979 - APRIL 1980
E. N. Ashmen 1980 80 p refs
(Contract DE-AC01-79CS-30027)
(DE81-028175; SOLAR/1045-80/14) Avail: NTIS HC A05/MF A01

An active solar energy system consisting of 950 square feet of flat plate collectos, gas fired auxiliary boilers, and 2000 gallons of storage was designed. The solar fractions actually achieved were 11% for heating and 44% for hot water. Measures of performance are given, including: solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance. The performance of the collector, storage, space heating and domestic hot water subsystems are discussed. DOE

N82-11564# McDonnell-Douglas Corp., Huntington Beach, Calif.
SECOND GENERATION HELIOSTAT, VOLUME 1 Final Report
D. A. Steinmeyer Apr. 1981 428 p Prepared for Sandia Labs., Livermore, Calif. 2 Vol.
(Contract DE-AC04-76DP-00789)
(DE81-029618; SAND-81-8177-Vol-1) Avail: NTIS HC A19/MF A01

The heliostat subsystem design is described. The test program is summarized, including component testing, subsystem operation and the shipment and installation. The production heliostat description, the manufacturing process definitions, and the manufacturing facility definition are summarized. The installation, operations, and maintenance requirements for the 50 MWe field are reviewed. Future development activities aimed at further cost reduction are discussed. DOE

N82-11566# Sandia Labs., Livermore, Calif.
STUDY OF PHOTOVOLTAIC COST ELEMENTS. VOLUME 1: EXECUTIVE REPORT, VOLUME 2: PROJECT BACKGROUND Final Report
James B. Ayers Jul. 1981 269 p Prepared in cooperation with Barry (Theodore) and Associates, Los Angeles 5 Vol.
(Contract DE-AC04-76DP-00789)
(DE81-030982; SAND-81-7014-Vol-1; SAND-81-7014-Vol-2) Avail: NTIS HC A12/MF A01

Two models used for estimating installation costs for residential and intermediate photovoltaic energy systems are summarized. The modeling rationale is reviewed, and the results obtained when the models were applied to 10 residential and 10 intermediate PV systems are listed. Output reports for each of the test cases are appended. DOE

N82-11567# Sandia Labs., Livermore, Calif.
STUDY OF PHOTOVOLTAIC COST ELEMENTS. VOLUME 3: SANDIA NATIONAL LABORATORIES PHOTOVOLTAIC SYSTEMS DESIGN CATALOG Final Report
James B. Ayers Jul. 1981 207 p Prepared in cooperation with Barry (Theodore) and Associates, Los Angeles
(Contract DE-AC04-76DP-00789)
(DE81-030986; SAND-81-7014-Vol-3) Avail: NTIS HC A10/MF A01

Basic system data sheets, which include project title and location, prime contractor, PV system general description, and energy storage capacity, are shown for 29 intermediate PV systems and 19 residential PV systems. In addition, cost data and output reports generated by TB and A's PV installation cost models are included for 10 intermediate systems and 10 residential systems. DOE

N82-11568# Sandia Labs., Livermore, Calif.
STUDY OF PHOTOVOLTAIC COST ELEMENTS. VOLUME 4: INSTALLATION COST MODEL FOR RESIDENTIAL PV SYSTEMS: USERS MANUAL Final Report
James B. Ayers Jul. 1981 89 p Prepared in cooperation with Barry (Theodore) and Associates, Los Angeles 5 Vol.
(Contract DE-AC04-76DP-00789)
(DE81-031921; SAND-81-7014-Vol-4) Avail: NTIS HC A05/MF A01

A quantitative methodology is presented for estimating installation costs of residential photovoltaic systems. The installation cost model for residential PV systems is comprised of 144 estimating equations selectively exercised, based on user definition of the system. At the input stage, residential PV systems can be fully described by 9 design option categories and 9 system specification categories. All assumptions were validated with installers of solar thermal systems. A discussion of the model is included as well as an example of its use with an 8 KW PV system for a Southwest all-electric residential design. DOE

N82-11569# Sandia Labs., Livermore, Calif.
STUDY OF PHOTOVOLTAIC COST ELEMENTS. VOLUME 5: INSTALLATION COST MODEL FOR INTERMEDIATE PV SYSTEMS: USERS MANUAL Final Report
James B. Ayers Jul. 1981 137 p Prepared in cooperation with Barry (Theodore) and Associates, Los Angeles 5 Vol.
(Contract DE-AC04-76DP-00789)
(DE81-030981; SAND-81-7014-Vol-5) Avail: NTIS HC A07/MF A01

A cost modeling methodology is presented for estimating installation costs associated with intermediate photovoltaic (PV) systems. With only a parametric description of an intermediate power system, the model can be used to develop an installation cost estimate for that system. The model is based on conventional cost-estimating procedures widely used by the construction industry and was validated by comparing estimates for the same 10 systems made independently by a cost engineering firm. A description of the model is included as well as an example of its use with a 200 KW solar breeder plant design to be located in Rockville, Maryland. DOE

N82-11575# Brookhaven National Lab., Upton, N. Y.
IMPURITY EFFECTS IN a-Si:H SOLAR CELLS
A. E. Delahoy and R. W. Griffith 1981 10 p refs Presented at 15th IEEE Photovoltaic Specialists Conf., Orlando, Fla., 12-15 May 1981
(Contract DE-AC02-76CH-00016)
(DE81-025069; BNL-29668; CONF-810526-38) Avail: NTIS HC A02/MF A01

The deleterious effects on device performance of phosphine and monochlorosilane are discussed. Solar cells fabricated using plasma deposited a-Si:H alloys can be degraded by the incorporation of certain impurities during deposition of the a-Si:H materials. Nominally intrinsic layers are adversely affected by the addition to the plasma of air, N2 + O2 mixtures, PH3 or SiH3Cl (monochlorosilane). Modification of the a-Si:H gap state density owing to synergistic effects of oxygen and nitrogen in the plasma leads to a collapse of the space charge region and the reduction of the micro tau product for holes. DOE

N82-11576# Sandia Labs., Livermore, Calif.
DESIGN, COST AND PERFORMANCE COMPARISONS OF SEVERAL SOLAR THERMAL SYSTEMS FOR PROCESS HEAT, VOLUME 1: EXECUTIVE SUMMARY
Patrick J. Eicker, Ernest D. Eason, Joe D. Hankins, Larry D. Hostetler, Joseph J. Iannucci, and James B. Woodward Mar 1981 24 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029881; SAND-79-8279-Vol-1) Avail: NTIS HC A02/MF A01

Conceptual designs of central receiver, parabolic dish, and perabolic trough systems for several process heat applications were analyzed. Cost and performance estimates are made for each of these designs and used to calculate levelized delivered process heat costs. This indicated that central receiver systems will provide energy costs competitive with that afforded by the parabolic trough and parabolic dish systems over the range of demand sizes and temperatures studies. DOE

N82-11577# Delaware Univ., Newark. Inst. of Energy Conversion.
Zn3P2 AS AN IMPROVED SEMICONDUCTOR FOR PHOTOVOLTAIC SOLAR CELLS Quarterly Report, 1 Dec. 1980 - 28 Feb. 1981
1981 49 p refs Prepared of Midwest Research Inst.
(DE81-025587; SERI/PR-8062-1-T12; QR-10) Avail: NTIS HC A03/MF A01

Zinc oxide zinc solar cells heterojunction devices were studied to establish the origin of the low open circuit voltage. Activation energy determination from JO vs. T-measurements, dark current voltage characteristics, and diffusion volage determination by high frequency capacitance voltage measurements are investigated development oriented Zn3P2 crystals is reported. The optical absorption and photoluminescence spectra of Mg3P2 was

measured and the diffusion by coefficient of magnesium in Zn3P2 was measured at 750C and 1500C by spectral response method. Diffusion of aluminum is also measured. The diffusion voltage of p/n junction devices to improving the fill factor is reported. DOE

N82-11883/ Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
SOLAR HEAT PUMP SIMULATOR
M. A. Catan 1981 5 p refs Presented at the Active Solar Contractors' Rev. Meeting, Washington, D.C., Sep. 1981
(Contract DE-AC02-76CH-00016)
(DE81-024368; BNL-29678; CONF-810912-3) Avail: NTIS HC A02/MF A01

A simulator was utilized to provide controlled-temperature sources and sinks to an experimental water-to-water laboratory heat pump test bed. This combination was used to demonstrate and explore the potential of the vapor-compression cycle to deliver high COP's at SAHP source temperatures. Results from the simulator were used in computer simulations of complete systems performed by BNL, by the SAHP contractors, and by others. A two-speed compressor was first tested at high source temperatures on the BNL simulator. In view of the decision by both contractors to construct water-to-air (rather than water-to-water) heat pumps, the BNL simulator was fitted with an air-side test loop. The prototype heat pump was tested under steady-state conditions on the BNL simulator. DOE

N82-11884/ Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
LOW-COST SOLAR FLAT-PLATE-COLLECTOR DEVELOPMENT
W. G. Wilhelm 1981 6 p Presented at the Active solar Contractors' Rev. Meeting, Washington, D.C., Sep. 1981
(Contract DE-AC02-76CH-00016)
(DE81-025081; BNL-29680; CONF-810912-4) Avail: NTIS HC A02/MF A01

Cost goals were developed for the collector which led to the rejection of conventional approaches and to the exploration of thin film technology. A thin film solar absorber suited for high speed continous-roll manufacture at low cost was designed. The absorber comprises two sheets of aluminum-foil/polymeric-material laminate bonded together at intervals to form channels with water as the heat transfer fluid. Several flat-plate panels were fabricated and tested. DOE

N82-11885/ California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
CONTROLS FOR SOLAR HEATING AND COOLING
M. Warren, Steven Schiller, and Michael Wahlig Jun. 1981 4 p refs Presented at the Active Solar Contractors' Rev. Meeting, Washington, D.C., Sep. 1981
(Contract W-7405-eng-48)
(DE81-025209; LBL-12751; CONF-810912-8) Avail: NTIS HC A02/MF A01

Solar heating system operation with two different operating strategies were run: direct collector to load heating and storage coupled heating. No significant improvement in system performance was found for the direct heating strategy. Simulation analysis of the interaction of the solar heating system with the building load and thermostat was completed. It is indicated that using a conventional room thermostat, large temperature swings can be expected when the storage tank is charged to a high temperature. DOE

N82-11889/ Los Alamos Scientific Lab., N. Mex.
TEST RESULTS AND ANALYSIS OF A CONVECTIVE LOOP SOLAR AIR COLLECTOR
Franz A. Biehl 1981 6 p refs Presented at the 6th Natl. Passive Solar Conf., Portland, Oreg., 8-12 Sep. 1981
(Contract W-7405-eng-36)
(DE81-028151; LA-UR-81-2252; CONF-810925-3) Avail: NTIS HC A02/MF A01

The purpose of the test program is to validate simulation model that can also be extended to other collector arrangements and to a variety of weather patterns. Details of the collector configurations, typical test results, simulation model, and comparison between test and analysis results are discussed. The good agreement between test and analysis suggests that the analytical model can be employed for sensitivity studies. A range of desirable collector lengths, based upon efficiency considerations, was determined employing the analytical model. DOE

N82-11890/ Los Alamos Scientific Lab., N. Mex.
LONG-TERM PERFORMANCE OF THE HUNN PASSIVE SOLAR RESIDENCE
B. D. Hunn 1981 6 p refs Presented at 6th Natl. Passive Conf., Portland, Oreg., 8-12 Sep. 1981
(Contract W-7405-eng-36)
(DE81-028735; LA-UR-81-2251; CONF-810925-6) Avail: NTIS HC A02/MF A01

Detailed performance and annual energy consumption data are reported, as well as occupant observations and conclusions, for three heating seasons in the Hunn hybrid passive/active solar residenced located in Los Alamos, New Mexico. The performance data were gathered by the Los Alamos National Laboratory and include hourly storage wall and interior temperature data for a midwinter period, an interior air-temperature histogram, and measured auxiliary energy consumption and solar heating fraction for each heating season. Also, energy and cost savings over the three-year period are estimated. DOE

N82-11892/ Los Alamos Scientific Lab., N. Mex.
HEAT STORAGE DURATION
J. Douglas Balcomb 1981 6 p refs Presented at 6th Natl. Passive Conf., Portland, Oreg., 8 Sep. 1981
(Contract W-7405-eng-36)
(DE81-026635; LA-UR-81-2186; CONF-810925-4) Avail: NTIS HC A02/MF A01

Both the amount and duration of heat storage in massive elements of a passive building are investigated. Data taken on one full winter in a solar home are analyzed with the aid of subsystem simulation models. Heat storage duration is tallied into day intervals. Heat storage location is discussed and related to overall energy flows. DOE

N82-11896/ Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
USE OF SOLAR THERMAL ENERGY TO GENERATE ELECTRICITY
L. M. Murphy Jul. 1981 22 p refs Presented at Energy in the Man-built Environ.: The Next Decade Specialty Conf., Vail, Colo., 3-5 Aug. 1981; sponsored by ASME
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-028797; SERI/TP-632-1287; CONF-810808-9) Avail: NTIS HC A02/MF A01

Solar thermal electric technology is reviewed. Technical approaches which result in net solar to electric conversion efficiencies ranging from less than 1 percent to more than 20 percent are discussed. The status of the various solar thermal electric concepts and the principal areas of research for each respective concept are reated. Cost issues and prospects for the economic competitiveness of solar thermal electric systems with conventional systems are outlined. DOE

N82-11898/ Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
NATIONAL PHOTOVOLTAIC PROGRAM IN AMORPHOUS MATERIALS
Jack Stone, Ed Sabisky, Harry Mahan, Tom McMahon, and Frank Jeffrey May 1981 6 p refs Presented at the 15th Photovoltaic Specialists Conf., Orlando, Fla. 12-15 May 1981
(Contracts DE-AC02-77CH-00178; EG-77-CH-01-4042)
(DE81-025908; SERI/TP-614-1218) Avail: NTIS HC A02/MF A01

The development of high efficiency (10% goal), cost effective (15-40 cents per peak watt goal), thin film solar cells is investigated. The status of this program, other research activities, and expected near term performance improvements are summarized. DOE

N82-11815/ Old North Mfg. Co., Inc., Lenoir, N.C.
SOL-CYCLE: A SOLAR-ASSISTED SOLVENT-RECYCLING PROCESS FOR ASPHALT-IMPREGNATION OF FIBER BOARD
Ben E. Edwards 1 Apr. 1981 12 p
(DE81-903377; NCEI-0031) Avail: NTIS HC A02/MF A01

To conserve resources and energy in the production of Flex-Joint, an asphalt-impregnated fiber board, a manufacturing

process was developed. The Sol-Cycle process provides for: (1) recycle of the solvent used in the saturation step, (2) conversion of raw to finished board in 24 hours, (3) better control of the saturation step; and (4) the use of solar energy for a part of the driving force to accomplish (1) and (2). DOE

N82-11617# Sandia Labs., Albuquerque, N. Mex.
PERFORMANCE TESTING OF THE TOLTEC TI-410 CONCENTRATING SOLAR COLLECTOR
V. E. Dudley (Edgerton, Germeshausen and Grier, Inc.) and R. M. Workhoven Jul. 1981 55 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029994; SAND-81-0389) Avail: NTIS HC A04/MF A01

Results of tests conducted on the collector are summarized. Collector efficiency, thermal loss, and receiver differential pressure were measured at fluid temperatures from 20 C to 200 C. The collector was evaluated with a glass mirror and with an acrylic/polyester film reflector surface. Four different receiver designs were tested. DOE

N82-11622# Lincoln Lab., Mass. Inst. of Tech., Lexington.
CARLISLE HOUSE: AN ALL-SOLAR ELECTRIC RESIDENCE
Burt E. Nichols and Steven J. Strong (Solar Design Associates, Lincoln, Mass.) 1981 4 p Presented at the 15th IEEE Photovoltaic Specialist Conf., Orlando, Fla., 11-15 May 1981 Sponsored by DOE
(DOE/ET-20279/133; CONF-810526-18) Avail: NTIS HC A02/MF A01

A solar photovoltaic array on the roof produces electricity, passive solar features provide much of the space heating, thermal collectors provide domestic hot water, and energy conservation measures reduce electrical and thermal energy requirements to a minimum. The overall performance of the system was reviewed. T.M.

N82-11623# Georgia Inst. of Tech., Atlanta. School of Social Sciences.
AN ASSESSMENT OF SELECTED SOLAR ENERGY INDUSTRY ACTIVITIES
J. David Roessner Nov. 1980 129 p refs
(PB81-222424; NSF/PRA-80-SP-1187) Avail: NTIS HC A07/MF A01 CSCL 05C

The past, present, and near-term conditions of four industries based on solar energy technologies are examined-solar heating; photovoltaics; concentrating solar collectors for process heat and electric power applications; and passive components such as skylights and greenhouses. The report identifies key, unresolved issues for government policies intended to influence future solar industrial development; assesses the past and current federal role in these industries; and draws tentative conclusions about how government policies have affected their evolution. This evolution is compared to the evolution of typical, innovation-based industries. For each of the four solar industries researched, the collected data are discussed as follows: characteristics of sales; the government role; investment strategies and R & D activities; near-term trends; and comparisons with other industries. GRA

N82-11626# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.
THE ROGERS FOCUSING HELIOSTAT EXPERIMENTAL PROGRAM AT RENSSELAER POLYTECHNIC INSTITUTE
W. E. Rogers, D. N. Borton, and M. P. Rice Dec. 1980 39 p Sponsored by New York State Energy Research and Development Authority
(PB81-226813; Rept-80-24; NYSERDA-80-24) Avail: NTIS HC A03/MF A01 CSCL 10A

A research effort to develop a solar collector package designed specifically with the needs and solar resources of the Northeast in mind is described. The heliostat is a concentrating solar collector which is 30 feet high, 34 feet wide and has 864 square feet of mirror concentrator. Electric controls move the structure so it tracks the path of the Sun as it rises and sets and moves across the sky. When the Sun is not shinning, the mirrors turn down, shielding them from the dirt, ice and snow. However, when it rains the mirrors turn up for cleaning, helping to keep them in peak operating condition. The heliostat's design incorporates a concentrating capability which takes the diffuse energy of the Sun and focuses it, creating temperatures of more than 3,600 F and producing enough steam as a result to displace 70 kW of electricity at peak operation. The w/it tested in this demonstration was used for space heating, and domestic hot water as well as to fire an absorption air conditioner. GRA

N82-12278# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.
SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB): REQUIREMENTS DEFINITION AND IMPACT ANALYSIS-2. VOLUME 2: DOMESTIC HOT WATER SYSTEMS
C. K. Cretcher Nov. 1980 121 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 553-2)
(DE82-900207; EPRI-EM-1506-Vol-2) Avail: NTIS HC A06/MF A01

The various types of solar domestic hot water systems are discussed including their advantages and disadvantages. The problems that occur in hydronic solar heating systems are reviewed with emphasis on domestic hot water applications. System problems in retrofitting of residential buildings are also discussed including structural and space constraints for various components and subsystems. System design parameters include various collector sizing methods, collector orientation, storage capacity and heat loss from pipes and tanks. The installation costs are broken down by components and subsystems. The approach used for utility economic impact analysis is reviewed. The simulation is described, and the results of the economic impact analysis are given. A summary assessment is included. DOE

N82-12280# Aerospace Corp., El Segundo, Calif. Energy and Resources Div.
SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB): REQUIREMENTS DEFINITION AND IMPACT ANALYSIS-2. VOLUME 3: CUSTOMER LOAD MANAGEMENT SYSTEMS
C. K. Cretcher and R. C. Rountredd Nov. 1980 87 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 553-2)
(DE82-900208; EPRI-EM-1506-Vol-3) Avail: NTIS HC A05/MF A01

Customer Load Management Systems, using off-peak storage and control at the residences, are analyzed to determine their potential for capacity and energy savings by the electric utility. Areas broadly representative of utilities in the regions around Washington, DC and Albuquerque, NM were of interest. Near optimum tank volumes were determined for both service areas, and charging duration/off-time were identified as having the greatest influence on tank performance. The impacts on utility operations and corresponding utility/customer economics were determined in terms of delta demands used to estimate the utilities' generating capacity differences between the conventional load management, (CLM) direct solar with load management (DSLM), and electric resistive systems. Energy differences are also determined. These capacity and energy deltas are translated into changes in utility costs due to penetration of the CLM or DSLM systems into electric resistive markets in the snapshot years of 1990 and 2000. DOE

N82-12540*# Boeing Aerospace Co., Seattle, Wash.
SPS LARGE ARRAY SIMULATION
S. Rathjen, B. R. Sperber, and Ervin J. Nalos *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 14-23

Avail: NTIS HC A99/MF A01 CSCL 10A

The computer programming efforts were directed primarily to beam pattern analysis. The computer programs used for simulation provide: verification of the reference design; definition of feasible departures such as quantized distributions; the study of far-out sidelobe roll-off characteristics; the analysis of errors and failures; illumination function analysis to develop beam patterns for efficient collection; and beam shaping synthesis to meet environmental constraints. T.M.

N82-12544*# LinCom Corp., Pasadena, Calif.
PERFORMANCE ANALYSIS AND SIMULATION OF THE SPS

REFERENCE PHASE CONTROL SYSTEM
W. C. Lindsey and C. M. Chie *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 59-74 refs

(Contract NAS9-15782)
Avail: NTIS HC A99/MF A01 CSCL 10A

Key results pertinent to the SPS reference phase control system design are summarized. These results are a consequence of extensive system engineering tradeoffs provided via mathematical modeling, optimization, analysis and the development/utilization of a computer simulation tool called SOLARSIM. T.M.

N82-12565*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
DESIGN AND BREADBOARD EVALUATION OF THE SPS REFERENCE PHASE CONTROL SYSTEM CONCEPT
P. M. Hopkins and V. R. Rao *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 75-84
(Contract NAS9-15800)
Avail: NTIS HC A99/MF A01 CSCL 10A

Efficient operation of a very large phased array such as the proposed solar power satellite, requires precision focusing and pointing of the power beam; i.e., the power beam must have a planar wavefront directed precisely at the center of the target antenna (rectenna). To maintain such a power beam requires real-time phase compensation at each subaperture in order to adjust for structural deformations and other transitory factors. In the current solar power satellite (SPS) baseline, the spaceborne antenna (Spacetenna) is an active retrodirective array. A pilot signal transmitted from the center of the rectenna is phase-conjugated at each subaperture (power module) of the spacetenna, thereby assuring that the radiated composite wave is focused on the target. This scheme requires a large amount of precision electronic circuitry on the spacetenna. Specifically, pilot receivers must be located at each power module and an adaptive distribution network is required in order to provide a properly phased reference signal at each conjugator. T.M.

N82-12578# Mazria (Edward) and Associates, Albuquerque, N. Mex.
PASSIVE SOLAR TECHNICAL PLANNING STUDY Final Report
Edward Mazria and M. S. Baker Oct. 1980 120 p refs
(EPRI-EM-1591; EPRI-TPS-79-750) Avail: NTIS HC A06/MF A01

The most promising passive solar techniques in buildings and their potential impact on electric utilities are examined. The differences between passive design and good energy conservation practices and the correlation between the passive solar contribution relative to reducing the building load from normal design practices are addressed. The potential for passive solar systems to alter residential load profiles, especially to reduce peaks for back-up energy needs is discussed. Computer code analysis techniques and capabilities required to simulate passive designs are presented. S.L.

N82-12599# Arizona Univ., Tucson. Solar Energy Research Facility.
GUIDEBOOK FOR SOLAR PROCESS-HEAT APPLICATIONS
Rocco Fazzolare, George Mignon, Leonel Campoy, and Francisco Luttmann Jan. 1981 169 p refs
(DE81-027977; DOE/TIC-1027977) Avail: NTIS HC A08/MF A01

The potential for solar process heat in Arizona and some of the general technical aspects of solar, such as insolation, siting, and process analysis are explored. Major aspects of a solar plant design are presented. Collectors, storage, and heat exchange are discussed. Reducing hardware costs to annual dollar benefits is also discussed. Rate of return, cash flow, and payback are discussed as they relate to solar systems. Design analysis procedures are presented. The design cost optimization techniques using a yearly computer simulation of a solar process operation is demonstrated. DOE

N82-12599# International Energy Agency, Paris (France).
OPTIMIZATION OF SOLAR HEATING AND COOLING SYSTEMS
T. L. Freeman (Atlas Corp., Santa Cruz, Calif.) Jun. 1981 58 p refs
(NP-1903997) Avail: NTIS (US Sales Only) HC A04/MF A01; DOE Depository Libraries

A review of general techniques and specific methods useful in the optimization of solar heating and cooling systems is undertaken. A discussion of the state of the art and the principal problems in both the simplified thermal performance analysis and economic analysis portions of the optimization problem are presented. Sample economic analyses are performed using several widely used economic criteria. The predicted thermal results of one typical, widely used simplified method is compared to detailed simulation results. A methodology for and the results of a sensitivity study of key economic parameters in the life cycle cost method are presented. Finally, a simple graphical optimization technique based on the life cycle cost method is proposed. DOE

N82-12600# Brookhaven National Lab., Upton, N. Y. Technology and Data Div.
COMPARATIVE ECONOMIC PERFORMANCE OF SELECTED PASSIVE SOLAR HEATING AND COOLING TECHNOLOGIES
W. Rutter May 1981 24 p refs
(Contract DE-AC02-76CH-00016)
(DE81-030220; BNL-51394) Avail: NTIS HC A02/MF A01

The economic performance of selected passive solar heating and cooling technologies which incorporate energy storage is assessed by using a set of uniform assumptions and methodologies. Where data are available, a given system is assessed at more than one geographical location. Results are obtained in the form of both payback period and net present value for residential applications, and in terms of net present value only for industrial/commercial uses. Results indicate that ventilated trombe walls, solar roof ponds, and certain night effect/floor storage strategies are cost effective, but night effect/rock bed cooling is not. Results also show that, although direct gain out-performs trombe walls in most parts of the country, both direct gain and trombe walls usually produce a net savings in the residential sector. Generally, however, tax regulations result in net economic loss for direct gain and trombe walls used to heat industrial and commercial buildings. DOE

N82-12601# Sandia Labs., Albuquerque, N. Mex. Thermal Sciences Div.
COMPARATIVE ECONOMICS OF SOLAR THERMAL CENTRAL RECEIVERS
Miriam J. Fish Aug. 1981 56 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029623; SAND-81-8236) Avail: NTIS HC A04/MF A01

For both electrical and industrial process heat (IPH) generation, central receivers compare favorably with oil and gas, and in many cases, coal. Calculational results are presented in which the levelized energy costs from central receiver plants are compared with those from oil, gas, and coal fired plants. Both electrical and IPH applications are discussed. Uncertainties in future capital costs, fuel price escalation rates, and the underlying economic climate are included in the analysis. DOE

N82-12602# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE: EXECUTIVE SUMMARY. VOLUME 1: FOR NEWMAN POWER STATION, EL PASO, TEXAS
Aug. 1981 9 p
(Contract DE-AC04-76DP-00789)
(DE81-031934; SAND-81-7100-Vol-1; MR-14) Avail: NTIS HC A02/MF A01

The data given for a 20 kWp photovoltaic flat panel power system for an uninterruptable power supply load includes: total electrical energy produced during the month of June 1981, and for each day of the month; total incident solar energy in the plane of the collector during the month and for each day of the month; and array efficiency. The monthly average direct normal insolation during the month during daylight hours is also reported. T.M.

N82-12608# Motorola, Inc., Phoenix, Ariz.
PHOTOVOLTAIC MECHANISMS IN POLYCRYSTALLINE

THIN FILM SILICON SOLAR CELLS Quarterly Technical Progress Report, 1 Feb. - 30 Apr. 1981
Bhushan Sopori 29 Aug. 1981 43 p refs
(Contract DE-AC02-77CH-00178)
(DE81-030370; DOE/SERI-9234/3; QTPR-3) Avail: NTIS HC A03/MF A01

Efforts are described in developing a technique for rapid identification of isolated line dislocations and dislocation networks in RTR ribbons. This was accomplished by extending the technique of Cu decoration to determine defect propagation in polycrystalline substrates. The basic characteristics of (100) textured surfaces are described, followed by a ray optics approach towards the analysis of textured surfaces, with and without AR coatings. The technique of optimization is demonstrated for a standard cell and an ultraviolet cell. DOE

N82-12609# Massachusetts Inst. of Tech., Cambridge.
PHOTOVOLTAIC MARKET ANALYSIS PROGRAM: BACKGROUND, MODEL DEVELOPMENT, APPLICATIONS AND EXTENSIONS
Gary L. Lilien and Frank H. Fuller Apr. 1981 158 p refs
(Contract DE-AM01-76EI-02295)
(DE81-029711; MIT-EL-81-012) Avail: NTIS HC A08/MF A01

Tools and procedures to help guide government spending decisions associated with stimulating photovoltaic market penetration were developed. The program has three main components: (1) theoretical analysis aimed at understanding qualitatively what general types of policies are likely to be most cost effective in stimulating PV market penetration; (2) operational model development (PV1), providing a user oriented tool to study quantitatively the relative effectiveness of specific government spending options and (3) field measurements, aimed at providing objective estimates of the parameters used in the diffusion model used in PV1. Existing models of solar technology diffusion are reviewed and the structure of the PV1 model is described. Theoretical results on optimal strategies for spending federal market development and subsidy funds are reviewed. The validity of these results is checked by comparing them with PV1 projections of penetration and cost forecasts for 15 government policy strategies which are simulated on the PV1 model. DOE

N82-12610# Massachusetts Inst. of Tech., Cambridge.
COST GOALS FOR A RESIDENTIAL PHOTOVOLTAIC/THERMAL LIQUID COLLECTOR SYSTEM SET IN THREE NORTHERN LOCATIONS
Thomas L. Dinwoodie and John P. Kavanaugh Oct. 1980 61 p refs
(Contract DE-AC02-78ET-20279)
(DE81-029700; MIT-EL-80-028) Avail: NTIS HC A04/MF A01

The allowable costs for a residential PV/T liquid collector system are compared with those of both PV only and side-by-side PV and thermal collector systems. Four types of conventional energy systems provide backup: all oil, all gas, all electric resistance, and electric resistance hot water with space heating by parallel heat pump. Electric space cooling is modeled, and the electric utility serves as backup for all electrical needs. The analysis is separated into two parts: (1) a base case study using conservative market and financial parameters for comparing PV/T economics in three northern locations; and (2) the sensitivity of PV/T economics to pertinent physical, market, and financial variables is examined. The difference in economic outlook for PV/T in retrofit applications is also estimated. It is indicated that, it for northern locations modeled, is less than that of separate (side-by-side) collector systems, at total array areas between 40-80 sq m. Below this range, allowable costs diverge, benefiting optimally sized separate collector systems. DOE

N82-12611# Midwest Research Inst., Perth (Australia). Solar Energy Research Inst.
STATUS OF SOLAR ENERGY RESEARCH AND DEVELOPMENT IN AUSTRALIA
Susan G. Saunders May 1981 28 p refs Presented at the Solar Systems Develop. Assoc., Tokyo, 27 May 1981
(NP-1903918; Rept-1007) Avail: NTIS HC A03/MF A01

The solar energy research and development program in Australia is described. Programs with promise of widespread application researched are: (1) solar industrial process heat; (2) solar air conditioning; (3) solar electricity production; and (4) biomass fuels. DOE

N82-12612# Mid-American Solar Energy Complex, Minneapolis, Minn.
SOLAR ENERGY INFORMATION DATA BANK (SEIDB) PROGRAM, FY 1981 Final Project Report
Jun. 1981 24 p
(Contract DE-AC02-79CS-30150)
(DE81-030054; MASEC/R-81-074) Avail: NTIS HC A02/MF A01

The background, program objectives, technical highlights, FY 81 program activity, and recommendations for the SEIDB are reviewed. DOE

N82-12615# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
NEAR-TERM IMPROVEMENTS IN PARABOLIC TROUGHS: AN ECONOMIC AND PERFORMANCE ASSESSMENT
R. Gee and L. M. Murphy Aug. 1981 54 p refs
(Contract DE-AC02-77CH-00178)
(DE82-001158; SERI/TR-632-870) Avail: NTIS HC A04/MF A01

Improved parabolic trough concentrating collectors which result from better design, improved fabrication techniques, and the development and utilization of improved materials are analyzed. The improvements considered are evacuated receivers, silvered glass reflectors, improved receiver, selective coatings, higher optical accuracy concentrations, and higher transmittance receiver glazings. Upper bound costs for each improvement are provided as well as estimates of the increased solar system rates of return that are made possible by these improvements. It is shown that the performance and economic potential of these improvements are substantial, especially at higher collector operating temperatures. DOE

N82-12616# Sandia Labs., Albuquerque, N. Mex. Theoretical Div.
USER'S GUIDE TO HELIOS: A COMPUTER PROGRAM FOR MODELING THE OPTICAL BEHAVIOR OF REFLECTING SOLAR CONCENTRATORS. PART 1: INTRODUCTION AND CODE INPUT
C. N. Vittitoe and Frank Biggs Aug. 1981 64 p refs
(Contract DE-AC04-76DP-00789)
(DE81-031920; SAND-81-1180-Pt-1) Avail: NTIS HC A04/MF A01

HELIOS is a flexible computer code for evaluating designs for central receiver, parabolic dish, and other reflecting solar energy collector systems, for safety calculations on the threat to personnel and to the facility itself, for determination of how various input parameters alter the power collected, for design trade offs, and for heliostat evaluations. Input variables include atmospheric transmission effects, reflector shape and surface errors, suntracking errors, focusing and alignment strategies, receiver design, placement positions of the tower and mirrors, and time of day and day of the year for the calculation. Complete input instructions and a description of the code structure are given. DOE

N82-12618# Sandia Labs., Livermore, Calif. Thermal Sciences Div.
SOLAR THERMAL CENTRAL RECEIVERS FOR INDUSTRIAL PROCESS HEAT GENERATION: USER VIEWS AND RECOMMENDATIONS FOR COMMERCIALIZATION
M. J. Fish Aug. 1981 66 p refs
(Contract DE-AC04-76DP-00789)
(DE81-029611; SAND-81-8235) Avail: NTIS HC A04/MF A01

Results of recent meetings with several private industrial groups in which solar thermal central receivers were discussed in depth as a potential for industrial process heat generation are summarized. Topics covering potential economics, technical requirements, and actions to promote commercialization of the technology are presented. These findings are then translated into recommendations for commercialization in private industrial markets. Key points include the need for small scale systems integration projects in addition to the 10 MW/sub e/ plant under construction at Barstow, CA, and the adoption of financial incentives, such as tax credits, for getting the early commercial plants built. DOE

N82-12623# Midwest Research Inst., Golden, Colo.
FLEXIBILITIES IN PASSIVE DESIGN: EXAMINING SOME LIMITING SOLAR MYTHS

R. G. Derickson and K. S. Sadlon Jul. 1981 5 p refs Presented at 6th Natl. Passive Conf., Portland, Oreg., 8 Sep. 1981
(Contract DE-AC02-77CH-00178)
(DE81-028401; SERI/TP-721-1342; CONF-810925-15) Avail: NTIS HC A02/MF A01

Frequently cited rules-of-thumb or general guidelines that needlessly limit designer choice and freedom are examined. It is found that a rectangular design with an E-W elongation is not really essential to proper passive design, east and west windows do not necessarily detract from passive heating performance or negatively impact cooling efficiency, and a passive house need not be crammed with thermal mass. Some flexible design alternatives are explored and factors other than E-W elongation, windows, and thermal mass are considered. DOE

N82-12624# Westinghouse Electric Corp., East Pittsburgh, Pa. Advanced Systems Technology Div.
ECONOMIC ASSESSMENT OF ADVANCED CENTRAL-RECEIVER SOLAR-THERMAL POWER SYSTEMS: EXECUTIVE SUMMARY
Oct. 1980 23 p refs
(Contract DE-AC03-79SF-10601)
(DOE/SF-10601/0) Avail: NTIS HC A02/MF A01

The value and potential electric utility impact of several advanced central receiver solar thermal plant concepts in the role of electric generating stations were estimated. Economics, the cost of producing electricity, fuels displaced, and utility system reliability are examined. The central receiver plants evaluated included solar/fossil hybrid concepts and solar stand-alone plants with thermal storage. It is indicated that if the cost goals are achieved and projected solar plant performance attained, the advanced solar thermal concepts can be competitive in regions with good insolation and some continued use of oil or other surrogate distillate or gaseous fuels. DOE

N82-12625# Oak Ridge National Lab., Tenn. Energy Div.
SEASONAL PERFORMANCE FACTORS FOR ACTIVE SOLAR SYSTEMS AND HEAT-PUMP SYSTEMS
R. L. Reid and L. A. Abbatiello 1981 7 p refs Presented at the IECEC Conf., Atlanta, 9 Aug. 1981
(Contract W-7405-eng-26)
(DE81-028569; CONF-810812-35) Avail: NTIS HC A02/MF A01

Methods of evaluating solar systems are discussed and compared. Heating seasonal performance factor (SPFH) and annual coefficient of performance (ACOP) are selected as being of the most value to the consumer in determining his purchased energy requirements and also allow the direct comparison of solar and heat pump systems. A search of the literature produced seasonal or annual data from 20 solar and 12 heat pump systems that were instrumented well enough to measure the loads and energy consumptions necessary to calculate the SPFH and/or ACOP. Tables of these results show that well-designed solar systems have SPFHs of 1.6 to 2.8 compared to heat pump SPFHs of 1.6 to 2.0. However, the heat pump Annual Cycle Energy System ACOP was measured as 3.1 compared to a projected maximum ACOP for a solar system with heat pump cooling of 2.4 to 2.8. DOE

N82-12626# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PERFORMANCE ANALYSIS OF 11 DENVER METRO PASSIVE HOMES
D. E. Claridge Jul. 1981 7 p refs Presented at the AS/ISES 6th Natl. Passive Solar Conf., Portland, Oreg., 8-12 Sep. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-025473; SERI/TP-721-1325; CONF-810925-12) Avail: NTIS HC A02/MF A01

The auxiliary heating requirements for 11 passive solar homes were calculated using SLR or SUNCAT-2.4 with a standard set of basic assumptions. It is shown that: seven of the homes should use less than half as much heating fuel as typical houses, two should use about half, and two should use about two-thirds or more. These results are compared with performance estimates and show large discrepancies. Differences are attributed largely to specific differences in assumptions in every case but one. DOE

N82-12627# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SUMMERTIME RESULTS FROM THE CLASS B PASSIVE-SOLAR PERFORMANCE-MONITORING PROGRAM
J. Swisher Jul. 1981 3 p Presented at the 6th Natl. Passive Solar Conf., Portland, Oreg., 8-12 Sep. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-025471; SERI/TP-721-1317; CONF-810925-8) Avail: NTIS HC A02/MF A01

The program is designed to provide, at relatively low cost, accurate and consistent real-time estimates of building thermal performance, as well as detailed data regarding climate, indoor temperatures, and purchased energy needs. As part of this program, a microprocessor-based data acquisition system was installed in each of ten passive solar houses in the Denver area, primarily to evaluate heating-season performance. During the summer, however, the monitoring systems are used to study the overheating tendencies of the buildings. Examination of the conditions that lead to overheating, using graphical and statistical techniques, will provide insight into the solar design practices that provide the most comfortable summer environment. DOE

N82-12628# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR EXPLOSION
B. C. Baccei Apr. 1981 5 p Presented at the 6th Natl. Passive Solar Conf., Portland, Oreg., 8-12 Sep. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-026086; SERI/TP-721-1167R; CONF-810925-13) Avail: NTIS HC A02/MF A01

The Solar Energy Research Institute (SERI) and the Department of Energy (DOE) Passive Solar Manufactured Buildings and Solar Home Builders Programs are developing much needed cost and performance data on solar buildings produced by large-volume home builders. These programs also serve as a model on how government can work effectively with industry. DOE

N82-12629# Los Alamos Scientific Lab., N. Mex.
PASSIVE-SOLAR-RETROFIT STUDY FOR THE UNITED STATES NAVY
William O. Wray and Charles R. Miles (Naval Civil Engineering Lab.) 1981 6 p refs Presented at the 6th Natl. Passive Solar Conf., Portland, Oreg., 8-12 Sep. 1981
(Contract W-7405-eng-36)
(DE81-028921; LA-UR-81-2200; CONF-810925-7) Avail: NTIS HC A02/MF A01

A passive solar retrofit study was conducted to determine the energy savings obtainable in concrete block buildings from several passive solar heating strategies. Test cell data and computer simulation were employed to assess the merits of six retrofit options. The six strategies selected were chosen on the basis of providing a series of options that deliver increasing energy savings at the cost of correspondingly increased levels of commitment. DOE

N82-12630# Los Alamos Scientific Lab., N. Mex.
ECONOMIC IMPLICATIONS OF PASSIVE-SOLAR RETROFIT FOR SINGLE-FAMILY RESIDENCES IN ALBUQUERQUE, NEW MEXICO: A CASE STUDY
S. W. Martin (Public Service Company of New Mexico, Albuquerque) Jun. 1981 125 p refs
(Contract W-7405-eng-36)
(DE81-028402; LA-8892-T) Avail: NTIS HC A06/MF A01

Certain economic criteria are used to evaluate the potential of retrofitted passive solar systems. Actual system and labor costs along with calculated Input-Output income and employment multipliers are used to estimate changes in income and employment levels within the study area. Estimates of changing energy use patterns also are presented. The methodology presented can be expanded to include other technologies and can be used to examine other potential scenarios. DOE

N82-12632# Sandia Labs., Albuquerque, N. Mex. Div. of Solar Technology.
DEPARTMENT OF ENERGY SOLAR CENTRAL RECEIVER SEMIANNUAL MEETING
Jan. 1981 273 p refs Meeting held in San Francisco, 15-16 Oct., 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-8049; CONF-8010128) Avail: NTIS HC A12/MF A01

The goals and current status of the solar thermal program were reviewed. The organization of the program is discussed, as

is funding for fiscal year 1981. Technical progress and future prospects are discussed. T.M.

N82-12940# Nationale Raad voor Landbouwkundig Onderzoek TNO, The Hague (Netherlands).
BASIS FOR RESEARCH PROPOSALS CONCERNING (INDUSTRIAL) SOLAR ENERGY PRODUCTION PROCESSES DERIVED FROM BIOLOGICAL PRINCIPLES [BASIS VOOR ONDERZOEKVOORSTELLEN BETREFFENDE (INDUSTRIELE) ZONNE-ENERGIEWINNINGSPROCESSEN AFGELEID VAN BIOLOGISCHE PRINCIPES]
1980 96 p refs In DUTCH
Avail: NTIS HC A05/MF A01

The economic feasibility of photochemical conversion systems for solar energy production processes derived from biological principles was studied. A global energy analysis shows that the period during which a solar energy installation has to deliver energy in order to regain the energy required for the construction is about one-seventh or one-eighth of its lifetime (10 times longer than conventional installations). Energy production with the help of photocatalytic systems in western Europe is only economical if the net conversion efficiency is substantially increased above 15%. Complex photocatalytic processes or combined photoelectric, photochemical and thermal mechanisms may be applied, i.e., coproduction, combining a photovoltaic or photocatalytic process with solar heat production or combining several photocatalytic systems. A tentative evaluation of conversion processes for solar energy is presented. Author (ESA)

N82-12942# Ludwig-Maximilians-Universitaet, Munich (West Germany). Inst. fuer Experimentalphysik.
IMPROVEMENT OF THERMAL EFFICIENCY OF FLAT PLATE SOLAR COLLECTORS Final Report
Hubert Boeck, Reinhard Hallermayer, Wolfgang Schoelkopf, and Alfred Wiesmeth Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 62 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-194; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 13

Measuring methods (spectral resolution of absorptivity and the evaluation of overall absorptivity with a solar spectrum) and further developed (calorimetric device to measure the hemispherical thermal emissivity of various speciments) were examined. The convective heat transfer between cover and absorber of a flat plate collector is partially suppressed by various inserted structures. The optical transmission of the cover of flat plate collectors is improved by interference layers. Thus an improvement is important when a correct azimuthal orientation of the collector is impossible. Results of an experimental comparative test of several commercial flat plate collectors are presented.
Author (ESA)

N82-12944# Technical Research Centre of Finland, Espoo. LVI-Tekniikan Lab.
THE PROPERTIES OF SOLAR AND HEAT PUMP HEATING SYSTEMS OF SMALL HOUSES AND ADDITIONAL HEAT SOURCES
Tino Kalema and Kari Wellman Apr. 1981 121 p refs In FINNISH; ENGLISH summary
(VTT-56; ISBN-951-38-1199-9; ISSN-0355-3469; RISO-M2241) Avail: NTIS HC A06/MF A01

The active use of solar energy in heating of small houses was studied with a computer program developed for this purpose. The calculations clear up the thermal properties of seven solar and heat pump systems with different operational principles. The following topics are studied: (1) how much energy is obtained from different heat sources (basic heat source, solar radiation, earth and wood); and (2) the influence of collector size, structure, and storage on the energy obtained from the collector in each system. The influence of the size and depth of the heat pump Earth pipes on compressor electricity consumption, Earth temperatures and freezing are also studied. Author (ESA)

N82-12947# Joint Publications Research Service, Arlington, Va.
SOLAR PROJECT AT ALMERIA NEARS COMPLETION
Hans Fricker *In its* W. Europe Rept.: Sci. and Technol., No. 72 (JPRS-78876) 1 Sep. 1981 p 15-17 Transl. into ENGLISH from Chem. Rundschau (Zurich), 25 May 1981 p 3 and 5
Avail: NTIS HC A03/MF A01

Ninety-three mirrors (heliostats), steered by a computer, reflect the sunlight at all times of the day and year into the opening of a combustion chamber (receiver) mounted on a 43-meter high tower in southern Spain. The cooling medium, liquid sodium, is heated from 270 C to 530 C, after which it flows to the hot storage tank installed on the ground below. As needed, sodium can be circulated out of the tank through the steam generator into a cold storage tank and from there back to be reheated in the receiver. The steam created in the steam generator expands in a steam engine; the mechanical energy created there drives the 500 kW generator, which produces the electric power. The selection of sodium as the cooling medium, and the design of the receiver and the pressure relief system which guarantees the safety of the plant in the unlikely event of a steam pipe bursting are described. A.R.H.

N82-12707# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
ENVIRONMENTAL DATA FOR SITES IN THE NATIONAL SOLAR DATA NETWORK
Aug. 1981 176 p Prepared for Argonne National Lab.
(Contract DE-AC01-79CS-30027)
(DE82-000071; SOLAR/0010-81/08) Avail: NTIS HC A09/MF A01

Environmental information collected at the sites of the National Solar Data Network is tabulated for each solar site. The sites are grouped into 12 zones, each of which consists of several adjacent states. The insolation table presents the total, diffuse, direct, maximum, and extraterrestrial radiation for the site. It also shows the ratio of total to extraterrestrial radiation. The temperature table gives the average, daytime, nighttime, maximum, minimum, and inlet-water temperature for the site. All of the passive and some active solar sites are equipped with wind sensors which provide information on wind speed and direction. For some sites, a humidity tables provides relative humidity values for day and night. It also gives values for the maximum and minimum humidity for each day. A technical discussion of the instruments and measurements used to obtain the data is included. DOE

N82-13039*# Hughes Research Labs., Malibu, Calif.
STUDY OF RADIATIVELY SUSTAINED CESIUM PLASMAS FOR SOLAR ENERGY CONVERSION Final Report, 1 Jul. 1978 - 30 Jun. 1980
A. J. Palmer and G. J. Dunning Jul. 1980 67 p refs
(Contract NAS2-10001)
(NASA-CR-166265) Avail: NTIS HC A04/MF A01 CSCL 10A

The results of a study aimed at developing a high temperature solar electric converter are reported. The converter concept is based on the use of an alkali plasma to serve as both an efficient high temperature collector of solar radiation as well as the working fluid for a high temperature working cycle. The working cycle is a simple magnetohydrodynamic (MHD) Rankine cycle employing a solid electrode Faraday MHD channel. Research milestones include the construction of a theoretical model for coupling sunlight in a cesium plasma and the experimental demonstration of cesium plasma heating with a solar simulator in excellent agreement with the theory. Analysis of a solar MHD working cycle in which excimer laser power rather than electric power is extracted is also presented. The analysis predicts a positive gain coefficient on the cesium-xenon excimer laser transition. R.J.F.

N82-13265# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
APPLIANCE EFFICIENCY AND THE SOLAR BUILDING
Joel Swisher Jun. 1981 30 p refs
(Contracts EG-77-C-01-4042; DE-AC02-77CH-00178)
(DE81-029073; SERI/TR-721-1119) Avail: NTIS HC A03/MF A01

Energy use in residential appliances is examined. Current appliance energy use was evaluated and technologically feasible improvements were studied. A typical set of household appliances was developed, and modified by three classes of efficiency improvements. Significant energy saving potential was found in all major appliance energy uses, with the largest savings in

water heaters and refrigerators. Costs of the improvements are relatively low, providing short payback times. The effects of the improvements on building thermal loads and electricity demand profiles were also examined. DOE

N82-13491*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SPACE APPLICABLE DOE PHOTOVOLTAIC TECHNOLOGY: AN UPDATE
J. Scott-Monck, P. Stella, and P. Berman. 15 Nov. 1981. 25 p. refs.
(Contract NAS7-100)
(NASA-CR-165021; JPL-Pub-81-91) Avail: NTIS HC A02/MF A01 CSCL 10A

Photovoltaic development projects applicable to space power are identified. When appropriate, the type of NASA support that would be necessary to implement these technologies for space use is indicated. It is conducted that the relatively small market and divergent operational requirements for space power are mainly responsible for the limited transfer of terrestrial technology to space applications. Information on the factors which control the cost and type of technology is provided. Terrestrial modules using semiconductor materials are investigated. S.L.

N82-13492*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DISTRIBUTED PHOTOVOLTAIC SYSTEMS: UTILITY INTERFACE ISSUES AND THEIR PRESENT STATUS
M. Hassan and J. Klein. 15 Sep. 1981. 166 p. refs.
(Contracts NAS7-100; DE-AI01-76ET-20356; JPL Proj. 5240-11)
(NASA-CR-165019; JPL-Pub-81-89; DOE/ET-20356/3) Avail: NTIS HC A08/MF A01 CSCL 10A

Major technical issues involving the integration of distributed photovoltaics (PV) into electric utility systems are defined and their impacts are described quantitatively. An extensive literature search, interviews, and analysis yielded information about the work in progress and highlighted problem areas in which additional work and research are needed. The findings from the literature search were used to determine whether satisfactory solutions to the problems exist or whether satisfactory approaches to a solution are underway. It was discovered that very few standards, specifications, or guidelines currently exist that will aid industry in integrating PV into the utility system. Specific areas of concern identified are: (1) protection, (2) stability, (3) system unbalance, (4) voltage regulation and reactive power requirements, (5) harmonics, (6) utility operations, (7) safety, (8) metering, and (9) distribution system planning and design. Author

N82-13496*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DISH STIRLING SOLAR RECEIVER COMBUSTOR TEST PROGRAM
C. P. Bankston and L. H. Back. 15 Aug. 1981. 45 p. refs.
(Contracts NAS7-100; DE-AI01-81ET-20307; JPL Proj. 5105-76)
(NASA-CR-165017; JPL-Pub-81-23; DOE/JPL-1060-41) Avail: NTIS HC A03/MF A01 CSCL 10A

The operational and energy transfer characteristics of the Dish Stirling Solar Receiver (DSSR) combustor/heat exchanger system was evaluated. The DSSR is designed to operate with fossil fuel augmentation utilizing a swirl combustor and cross flow heat exchanger consisting of a single row of 4 closely spaced tubes that are curved into a conical shape. The performance of the combustor/heat exchanger system without a Stirling engine was studied over a range of operating conditions and output levels using water as the working fluid. Results show that the combustor may be started under cold conditions, controlled safely, and operated at a constant air/fuel ratio (10 percent excess air) over the required range of firing rates. Furthermore, nondimensional heat transfer coefficients based on total heat transfer are plotted versus Reynolds number and compared with literature data taken for single rows of closely spaced tubes perpendicular to cross flow. The data show enhanced heat transfer for the present geometry and test conditions. Analysis of the results shows that the present system meets specified thermal requirements, thus verifying the feasibility of the DSSR combustor design for final prototype fabrication. J.M.S.

N82-13498*# Solarex Corp., Rockville, Md.
A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT (MEPSDU) Quarterly Report, 1 May - 31 Aug. 1981
31 Aug. 1981. 57 p. refs. Sponsored in part by DOE. Prepared for JPL, Pasadena.
(Contract JPL-955902)
(NASA-CR-165014; QR-3; JPL-9950-603; DOE/JPL-955902-81/3) Avail: NTIS HC A04/MF A01 CSCL 10A

A cost effective process sequence and machinery for the production of flat plate photovoltaic modules are described. Cells were fabricated using the process sequence which was optimized, as was a lamination procedure. Insulator tapes and edge seal material were identified and tested. Encapsulation materials were evaluated. S.L.

N82-13501*# Spectrolab, Inc., Sylmar, Calif.
HIGH RESOLUTION, LOW COST SOLAR CELL CONTACT DEVELOPMENT Final Report
N. Mardesich [1981] 82 p. Sponsored in part by DOE. Prepared for JPL, Pasadena, Calif.
(Contract JPL-955725)
(NASA-CR-165032; JPL-9950-611; DOE/JPL-955725-81/1) Avail: NTIS HC A05/MF A01 CSCL 10A

The MIDFILM cell fabrication and encapsulation processes were demonstrated as a means of applying low-cost solar cell collector metallization. The average cell efficiency of 12.0 percent (AM1, 28 C) was achieved with fritted silver metallization with a demonstration run of 500 starting wafers. A 98 percent mechanical yield and 80 percent electrical yield were achieved through the MIDFILM process. High series resistance was responsible for over 90 percent of the electrical failures and was the major factor causing the low average cell efficiency. Environmental evaluations suggest that the MIDFILM cells do not degrade. A slight degradation in power was experienced in the MIDFILM minimodules when the AMP Solarlok connector delaminated during the environmental testing. T.M.

N82-13514# Solarex Corp., Rockville, Md.
SILICON SOLAR CELL OPTIMIZATION Final Report, 15 Aug. 1978 - 15 Feb. 1981
Alan L. Scheinine, John H. Wohlgemuth, and Eileen Sparks. Wright-Patterson AFB, Ohio AFWAL Jun. 1981. 99 p. refs.
(Contract F33615-78-C-2039; AF Proj. 3145)
(AD-A106005; AFWAL-TR-81-2052) Avail: NTIS HC A05/MF A01 CSCL 10/2

This research program has resulted in improvements in vertical junction solar cell techniques leading to higher efficiencies and improved handleability. Vertical junction solar cells have now been fabricated with AMO conversion efficiency greater than 15% (25 C). A variety of cells have been fabricated including different groove depths, substrate thicknesses and bulk resistivities. Cell performance has been measured both before and after irradiation. Theoretical analyses has been performed to generate computer models of I-V curves for various cell geometries. Author (GRA)

N82-13528# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
INEXPENSIVE THERMOGRAPHIC TECHNIQUES FOR DETERMINING RELIABLE SOLAR-COLLECTOR-ARRAY PERFORMANCE
A. Edan and T. Haverty. Sep. 1981. 35 p. refs.
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-001151; SERI/TR-721-1161) Avail: NTIS HC A03/MF A01

Thermographic equipment, capable of detecting flow blockages, flow imbalances, and total array shutdown in residential and commercial solar energy collector systems is investigated. The abilities of inexpensive thermographic equipment to perform solar array examinations in the field environment are described. It was found that less expensive instruments, in combinations to enhance the capabilities of each general type, can be used to examine solar collector arrays. Expert infrared equipment operators are not required to obtain some conclusions on system problems. A combination of pot radiation thermometers with either a hand-held imager or thermoprofile instrument is a viable inspection tool. Assessment of reliable flow control components, blocked collectors, unbalanced flow distribution, and reversed flow can all be observed with the combination of instruments. DOE

N82-13530# Sandia Labs., Livermore, Calif.
SOLAR-CENTRAL-RECEIVER FUELS AND CHEMICALS Project Status Report, Oct. 1980 - Jun. 1981
R. W. Carling, J. D. Fish, L. G. Radosevich, and J. Vitko, Jr. Aug. 1981 22 p refs
(Contract DE-AC04-76DP-00789)
(DE82-000941; SAND-81-8232) Avail: NTIS HC A02/MF A01

Solar central receiver fuels and chemicals processes were studied. Ethane pyrolysis and steam reforming of methane were investigated in-depth in addition to coal gasification, oil shale retorting, and biomass flash pyrolysis. The study criteria, status of ongoing work, and future activities are described. DOE

N82-13531# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR THERMAL ENERGY SYSTEMS Annual Technical Progress Report
Jul. 1981 157 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-1012)
(DE81-029295; DOE/CS-4042/2) Avail: NTIS HC A08/MF A01

Technical progress in the solar thermal energy systems program is summarized. Each project description includes a brief history, significant achievements, future activities, and a forecast of anticipated achievements. Point focus, central receiver and line focus technologies, research and advanced development components, materials, fuels and chemicals, and solar ponds are discussed. DOE

N82-13532# Sandia Labs., Albuquerque, N. Mex.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 2 FOR BEVERLY HIGH SCHOOL, BEVERLY, MASS.
Sep. 1981 21 p Prepared in cooperation with Boeing Computer Services Co., Seattle, Wash.
(Contract DE-AC04-76DP-00789)
(DE82-000811; SAND-81-7088-2) Avail: NTIS HC A02/MF A01

Performance data were listed and graphed for an intermediate photovoltaic system at a high school in Massachusetts for the month of July 1981. The energy production, incident solar energy and efficiency are given, and the daily energy production and efficiency, and energy production as a function of power and voltage are graphed. The output of the power conditioner, insolation, heating and cooling loads, temperature and wind data, and the number of freeze thaw cycles are presented. DOE

N82-13533# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DATA REPORT FOR THE NORTHEAST RESIDENTIAL EXPERIMENT STATION, JUNE 1981
M. C. Russell, P. Raghuraman, and J. J. Farrell Aug. 1981 14 p
(Contract DE-AC02-76ET-20279)
(DE82-000068; DOE/ET-20279/154) Avail: NTIS HC A02/MF A01

Five prototype residential photovoltaic systems consisting of a roof-mounted array, sized to meet at least 50 percent of the annual electrical demand of an energy-conserving house, and an enclosed structure to house the remainder of the photovoltaic equipment, test instrumentation, and work space are being monitored to provide authoritative and accurate information concerning system performance and the typical loads which they serve. One month of physical data is presented for each system as well as an hour-by-hour tabulation for an average day of the month. A common feature of all the systems is that excess solar-generated electric energy is fed back to the utility grid, thus eliminating the need for on-site storage. A.R.H.

N82-13543# California Univ., Livermore. Lawrence Livermore Lab.
DESIGN AND TEST OF TWO-STEP SOLAR OIL SHALE RETORT
D. W. Gregg, R. W. Taylor, W. R. Aiman, and R. Ruiz 24 Sep. 1981 35 p refs
(Contract W-7405-eng-48)
(DE82-000964; UCID-19199) Avail: NTIS HC A03/MF A01

A design of a two step solar retort, the logic for the design, and the results from a preliminary test of the design at the White Sands Solar Furnace, New Mexico are presented. Solar retorting of oil shale is a technically feasible process where focused solar energy can displace fossil energy in the production of liquid fuels. The predicted result is a 10 to 40% improvement in the exportable fuel (oil + gas) production per ton of raw shale. Greater improvements are achieved with the lower grade shales where with nonsolar processes a larger fraction of the fuel content has to be used in the processing. DOE

N82-13548# Swedish Inst. for Materials Testing, Boras. Lab foer Ytskydd och Korrosion.
AGING AND CORROSION PROBLEMS WITH FLAT SOLAR ENERGY ABSORBERS. STUDY BASED UPON LITERATURE AND EXPERIMENT EXCHANGES [AALDRINGS-OCH KORROSIONS-PROBLEM HOS PLANA TERMISKA SOLFAANGARE. EN STUDIE BASERAD PAA LITTERATUR OCH ERFARENHETSUTBYTE]
Hans Wennerholm and Knut-Olof Lagerkvist 1979 72 p refs In SWEDISH
(SP-RAPP-1979/4) Avail: NTIS HC A04/MF A01

The construction and the causes of damage to solar energy absorbers are reviewed. Aging is due to ultraviolet radiation, temperature, humidity, oxygen, impurities in the air and other effects. A literature review is given about the constituent parts. The coverplate may be of glass, several types of plastics, fluoro-compounds, fiberglass, or silicones. For the absorbing surface, sintered chromium oxide, black nickel, black iron, copper oxide, manganese oxides, or selective coated aluminium are used. The insulation is often made of mineral wool or polyurethane resins. Inspection data are reported for nine solar flat-shaped energy absorbers. Most of them are used for the production of warm water and have been in use between three months and three years. Nearly all coverplates bore important deposits caused by condensation. Some of the nine aborbers show corrosion on the aborbing surface and/or on insulation. Author (ESA)

N82-13549# National Bureau of Standards, Washington, D.C.
PASSIVE/HYBRID SOLAR COMPONENTS. AN APPROACH TO STANDARD THERMAL TEST METHODS
M. E. McCabe, W. Dukes, M. J. Orloski, and K. N. Decorte Jul. 1981 87 p refs Sponsored in part by DOE
(PB81-227886; NBSIR-81-2300) Avail: NTIS HC A05/MF A01 CSCL 14B

A survey of passive solar products currently available or under development enabled the development of an interim classification system consisting of ten component classifications for purposes of thermal testing. A survey of currently available thermal test procedures was performed to assess the applicability of these test methods for passive/hybrid solar components. Existing test procedures that are useful for the direct gain fenestration system classification are identified, and recommendations are made for evaluation of these laboratory-based procedures by comparison with field-based testing of components under controlled interior conditions. Recommendations are also made for the development of new test procedures for passive/hybrid components classifications for which existing test methods are not applicable. GRA

N82-14384# New Hampshire Univ., Durham. Dept. of Chemical Engineering.
FUELS AND CHEMICALS MADE FROM SOLAR ENERGY
V. K. Mathur, F. K. Manasse, and S. Lakshmanan 1981 10 p refs Presented at the 2nd World Congr. of Chem. Engr., Montreal, Canada, 4-9 Oct. 1981
(Contract DE-AC02-79ET-21067)
(DE81-025018; CONF-811007-6) Avail: NTIS HC A02/MF A01

The application of high temperature solar energy for the production of fuels and chemicals from various feed stocks is reviewed. The promises and problems of this technology are highlighted. The two-stage Sun gas process is described. The role of chemical engineers and the future of Sun fuels and chemicals are discussed. DOE

N82-14627*# DHR, Inc., Washington, D.C.
MARKET ASSESSMENT OF PHOTOVOLTAIC POWER SYSTEMS FOR AGRICULTURAL APPLICATIONS IN MOROCCO Final Report
Henry Steingass and Itil Asmon (ARD, Inc.) Sep. 1981 157 p refs

(Contract DEN3-180; DE-AI01-79ET-20485)
(NASA-CR-165477; DOE/NASA/0180-2; C4100-50) Avail: NTIS HC A08/MF A01 CSCL 10A

Results of a month-long study in Morocco aimed at assessing the market potential for stand-alone photovoltaic systems in agriculture and rural service applications are presented. The following applications, requiring less than 15 kW of power, are described: irrigation, cattle watering, refrigeration, crop processing, potable water and educational TV. Telecommunications and transportation signalling applications, descriptions of power and energy use profiles, assessments of business environment, government and private sector attitudes towards photovoltaics, and financing were also considered. The Moroccan market presents both advantages and disadvantages for American PV manufacturers. The principle advantages of the Moroccan market are: a limited grid, interest in and present use of PV in communications applications, attractive investment incentives, and a stated policy favoring American investment. Disadvantages include: lack of government incentives for PV use, general unfamiliarity with PV technology, high first cost of PV, a well-established market network for diesel generators, and difficulty with financing. The market for PV in Morocco (1981-1986), will be relatively small, about 340 kwp. The market for PV is likely to be more favorable in telecommunications, transport signalling and some rural services. The primary market appears to be in the public (i.e., government) rather than private sector, due to financial constraints and the high price of PV relative to conventional power sector. M.D.K.

N82-14630*# Ross (Bernd) Associates, San Diego, Calif.
DEVELOPMENT OF AN ALL-METAL THICK FILM COST EFFECTIVE METALLIZATION SYSTEM FOR SOLAR CELLS Quarterly Report, Nov. 1980 - Apr. 1981
Bernd Ross Sep. 1981 40 p refs
(Contract JPL-955688)
(NASA-CR-165043; DOE/JPL-955688-80/3; JPL-9950-604; QR-3) Avail: NTIS HC A03/MF A01 CSCL 10A

The objectives of the investigation were to provide all-metal screenable pastes using economical base metals, suitable for application to low-to-high conductivity silicon of either conductivity type and possibly to aluminum surfaces. Experiments were conducted with variations in paste parameters, firing conditions, including gas ambients, furnace furniture, silicon surface and others. A liquid medium, intended to provide transport during the carbon fluoride decomposition was incorporated in the paste with promising results. T.M.

N82-14631*# Solarelectronics, Inc., Bellingham, Mass.
FLAT-PLATE SOLAR ARRAY PROJECT. TASK 1: SILICON MATERIAL: INVESTIGATION OF THE HYDROCHLORINATION OF SiC1SUB4 Quarterly Report, 9 Jul. - 30 Sep. 1981
Jeffrey Y. P. Mui 1 Oct. 1981 17 p refs
(Contract JPL-956061)
(NASA-CR-165042; DOE/JPL-956061/1; JPL-9950-607) Avail: NTIS HC A02/MF A01 CSCL 10A

A two inch-diameter stainless steel reactor was designed to operate at pressure up to 500 psig and at temperature up to 600 C in order to study the hydrochlorination of silicon tetrachloride and metallurgical grade (m.g.) silicon metal to trichlorosilane. The hydrochlorination apparatus is described and operation safety and pollution control are discussed. A.R.H.

N82-14634*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATELLITE POWER SYSTEM: CONCEPT DEVELOPMENT AND EVALUATION PROGRAM. VOLUME 4: ENERGY CONVERSION AND POWER MANAGEMENT
Nov. 1981 369 p refs
(NASA-TM-58237-Vol-4) Avail: NTIS HC A16/MF A01 CSCL 10A

Additional analyses that were performed to supplement the NASA/Department of Energy (DOE) Satellite Power System (SPS) reference system concept are presented in this volume. A brief review of the reference concept is provided together with detailed descriptions of energy conversion, power distribution, and power management for solar photovoltaics (silicon and gallium arsenide), solar thermal (Brayton and Rankine cycles), and concept comparisons (solar thermal and energy conversion). Results of other studies concerning energy conversion and power management (environmental impacts, annealing, nuclear SPS concept, and thermionic) are included. The data presented were taken from the SPS Concept Definition Studies performed under the direction of NASA by Rockwell International Corporation and Boeing Aerospace Company. Author

N82-14635*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATELLITE POWER SYSTEM: CONCEPT DEVELOPMENT AND EVALUATION PROGRAM. VOLUME 7: SPACE TRANSPORTATION
Nov. 1981 258 p refs
(NASA-TM-58238-Vol-7) Avail: NTIS HC A12/MF A01 CSCL 10A

During the several phases of the Satellite Power System (SPS) Concept Definition Study, various transportation system elements were synthesized and evaluated on the basis of their potential to satisfy overall SPS transportation requirements and their sensitivities, interfaces, and impact on the SPS. Additional analyses and investigations were conducted to further define transportation system concepts that will be needed for the developmental and operational phases of an SPS program. To accomplish these objectives, transportation systems such as the Shuttle and its derivatives have been identified; new heavy-lift launch vehicle (HLLV) concepts, cargo and personnel orbital transfer vehicles (COTV and POTV), and intra-orbit transfer vehicle (IOTV) concepts have been evaluated; and, to a limited degree, the program implications of their operations and costs were assessed. The results of these analyses have been integrated into other elements of the overall SPS concept definition studies. Author

N82-14636*# General Dynamics/Convair, San Diego, Calif.
STUDY OF MULTI-MEGAWATT TECHNOLOGY NEEDS FOR PHOTOVOLTAIC SPACE POWER SYSTEMS. VOLUME 1: EXECUTIVE SUMMARY
D. M. Peterson and R. L. Pleasant 1 Aug. 1981 28 p refs 2 Vol.
(Contract NAS3-21951)
(NASA-CR-165323-Vol-1; Rept-111-2401-204) Avail: NTIS HC A03/MF A01 CSCL 10A

Possible missions requiring multimegawatt photovoltaic space power systems in the 1990's time frame and associated power system technology needs are examined. The following concepts for photovoltaic power approaches are considered: planar arrays, concentrating arrays, hybrid systems using Rankine engines, thermophotovoltaic and AC/DC power management approaches, battery, fuel cell, flywheel energy storage, and interactions with the electrical ion engine injection and stationkeeping system. The levels of modularity for efficient, safe, constructable, serviceable, and cost effective system design are analyzed, and the benefits of alternate approaches developed. Both manned low Earth orbit and unmanned geosynchronous Earth orbit applications were examined for technological development. Technology developments applicable to power systems which appear to have benefits independent of the absolute power level are suggested. M.D.K.

N82-14637*# General Dynamics/Convair, San Diego, Calif.
STUDY OF MULTI-MEGAWATT TECHNOLOGY NEEDS FOR PHOTOVOLTAIC SPACE POWER SYSTEMS, VOLUME 2 Final Report
D. M. Peterson and R. L. Pleasant 19 Mar. 1981 285 p refs 2 Vol.
(Contract NAS3-21951)
(NASA-CR-165323-Vol-2; GDC-AST-81-019-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 10A

Possible missions requiring multimegawatt photovoltaic space power systems in the 1990's time frame and power system technology needs associated with these missions are examined. Four specific task areas were considered: (1) missions requiring power in the 1-10 megawatt average power region; (2) alternative power systems and component technologies; (3) technology goals and sensitivity trades and analyses; and (4) technology recommendations. Specific concepts for photovoltaic power approaches considered were: planar arrays, concentrating arrays, hybrid systems using Rankine engines, thermophotovoltaic approaches; all with various photovoltaic cell component technologies. Various AC/DC power management approaches, and battery, fuel cell, and flywheel energy storage concepts are evaluated. Interactions with the electrical ion engine injection and stationkeeping system are also considered. M.D.K.

N82-14843# Arabian Exhibition Management Ltd., Manama (Bahrain).
SOLTECH 80
1980 174 p Conf. held at Bahrain, 10-11 Nov. 1980
(DE81-901931; CONF-801178) Avail: NTIS (US Sales Only) HC A08/MF A01; DOE Depository Libraries

Three solar related activities: solar radiation monitoring, effects of dust accumulation on collector performance, and salt gradient solar pond analytical and experimental studies are described. Measurements of total horizontal and direct radiation are made continuously, and the data are presented in a user oriented format on an hourly basis. Diffuse radiation and total radiation on a surface tilted to the local latitude angle are calculated. The system is presently being expanded to allow measurement of several additional radiation parameters of interest as well as six meteorological parameters. The effects of atmospheric dust on radiation attenuation, as well as the clearness index, anti K/sub T/ are shown. The impact of surface dust accumulation on the performance of photovoltaic and thermal collectors is also studied. DOE

N82-14856# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PHOTOVOLTAIC SYSTEMS PERFORMANCE EXPERIENCE
F. J. Solman 1981 8 p refs Presented at IEEE Photovoltaic Specialists Conf., Orlando, Fla., 11-15 May 1981
(Contract DE-AC02-76ET-20279)
(DE81-025725; DOE/ET-20279/147; CONF-810526-39) Avail: NTIS HC A02/MF A01

The photovoltaic power systems at Natural Bridges National Monument in southeastern Utah and at radio station WBNO in Bryan, Ohio, provided reliability experience and case histories on failures and repairs of large photovoltaic systems. The PV systems are used for illustration of potential sources of system outages and measures that can be taken to improve the reliability and repair economy of present and future PV systems. Both systems have experienced lighting strikes, and the results are reported. E.A.K.

N82-14857# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLAR PHOTOVOLTAIC RESIDENTIAL PROJECT. PROJECT INTEGRATION MEETING, AGENDA AND ABSTRACTS
1981 63 p refs Presented at Solar Photovoltaic Residential Project Integration Meeting, Cambridge, Mass., 24-25 Jun. 1981
(Contract DE-AC02-76ET-20279)
(DE81-028433; DOE/ET-20279/150; CONF-8106143) Avail: NTIS

Thirty three abstracts are presented covering: residential photovoltaic design, economics and requirements, balance of system components, PV/thermal collectors, PV interfaced with passive solar design, and utilities related aspects. DOE

N82-14858# Midwest Research Inst., Golden, Colo.
SYSTEMS ANALYSIS OF THERMAL STORAGE
R. J. Copeland Aug. 1981 8 p refs Presented at the Ann. Meeting on Thermal and Chem. Storage, Tysons Corner, Va., 14-16 Sep. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-030288; SERI/TP-253-1369; CONF-81840-2) Avail: NTIS HC A02/MF A01

Analyses were conducted on thermal storage concepts for solar thermal applications. These studies include estimates of both the obtainable costs of thermal storage concepts and their worth to a user (i.e., value). Based on obtainable costs and performance, an in-depth study evaluated thermal storage concepts for water/steam, organic fluid, and gas/Brayton solar thermal receivers. Promising and nonpromising concepts were identified. Thermal storage concepts were evaluated for a liquid metal receiver. The value of thermal storage in a solar thermal industrial process heat application was analyzed. Several advanced concepts studied, include ground-mounted thermal storage for parabolic dishes with Stirling engines. DOE

N82-14861# Mid-American Solar Energy Complex, Minneapolis, Minn.
SEMINARS FOR PRIVATE COLLEGE ADMINISTRATORS ON SOLAR APPLICATIONS FOR COLLEGE BUILDINGS
Jun. 1981 8 p
(Contract DE-AC02-79CS-30150)
(DE81-027981; MASEC-CF-81-038) Avail: NTIS HC A02/MF A01

The objective of this project was to increase the working knowledge of key private college decision makers on passive and active solar fundamentals, proven passive and active technology, and conservation means integral to these technologies in the renovation of college buildings or their energy systems, to be achieved by conducting a series of three seminars. A summary of the project activities and a brief summary of workshop evaluations are given. DOE

N82-14865# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
REPEAT FACILITY. REPORT FOR MAY, JUNE, JULY Progress Report, May - Jul. 1981
C. Byron Winn Aug. 1981 79 p refs
(Contract DE-AS02-80CS-30259)
(DE81-028156; DOE/CS-30259/6) Avail: NTIS HC A05/MF A01

The construction of the REPEAT facility, a test facility for passive and hybrid solar heating systems is reported. The development of a simulation program for envelope type passive solar systems, constructing an envelope test cell, collecting data to validate the program, and application of the program to determine the best envelope type design are discussed. A low cost monitoring system using a dedicated microprocessor system, an inexpensive, high accuracy A/D converter, and minimum system hardware is developed. A method to determine the average temperature and the average daily temperature variation inside a passively heated solar building is presented. DOE

N82-14868# Department of Agriculture, Washington, D.C. National Economics Div.
SOLAR-SUPPLEMENTED, NATURAL AIR DRYING OF SHELLED CORN: THE ECONOMIC LIMITATIONS
Walter G. Heid, Jr. and David F. Aldis Jun. 1981 45 p refs
(PB81-235681; TB-1654) Avail: NTIS HC A03/MF A01 CSCL 02C

It is not economically feasible to supplement natural air drying of high-moisture shelled corn by adding heat (solar and otherwise). In some cases, that drying method speeds product deterioration. A simulation analysis of the west central Great Plains determined that benefits from adding solar heat to batch-in-bin and layer-in-bin grain drying methods failed to offset the solar heat installation costs and product deterioration losses. Findings also suggest that high-speed, high-temperature drying is necessary to avoid field losses and to ensure marketable corn of high quality. GRA

N82-15247# Argonne National Lab., Ill.
PERFORMANCE PREDICTIONS OF PASSIVE SOLAR COMMERCIAL BUILDINGS
T. L. Kurbowski 1981 5 p refs Presented at 2nd Natl. Tech. Conf. on Earth Sheltered Buildings, Tulsa, Okla., 16 Oct. 1981
(Contract W-31-109-eng-38)
(DE81-027979; CONF-811034-1) Avail: NTIS HC A02/MF A01

Many Earth bermed and high mass commercial structures tending to require cooling and lighting rather than heating were designed, built, and instrumented to record segregated or partitioned energy usage. Design solutions, preliminary performance, and cost information are addressed for the earth integrated projects. DOE

N82-15526*# Vanderbilt Univ., Nashville, Tenn. Dept. of Physics and Astronomy.
ADVANCED SOLAR ENERGY CONVERSION Annual Progress Report, 1 Sep. 1980 - 31 Aug. 1981
Ja H. Lee 31 Aug. 1981 22 p refs
(Contract NCC1-8)
(NASA-CR-165060) Avail: NTIS HC A02/MF A01 CSCL 10A

An atomic iodine laser, a candidate for the direct solar pumped lasers, was successfully excited with a 4 kW beam from a xenon arc solar simulator, thus proving the feasibility of the concept. The experimental set up and the laser output as functions of operating conditions are presented. The preliminary results of the iodine laser amplifier pumped with the HCP array to which a Q switch for giant pulse production was coupled are included. Two invention disclosures - a laser driven magnetohydrodynamic generator for conversion of laser energy to electricity and solar pumped gas lasers - are also included. S.L.

N82-15529# Varta Batterie A.G., Kelkheim (West Germany). Forschungs- und Entwicklungszentrum.
ENERGY STORAGE SYSTEMS FOR TERRESTRIAL SOLAR GENERATORS Final Report, Dec. 1980
Margarete Jung Bonn Bundesministerium fuer Forschung und Technologie May 1981 76 p refs In GERMANY; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-082; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 16

Mercury can react with Raney nickel to form the alloy NiHg4. This intermetallic compound is the basis of an excellently rechargeable positive electrode material. In combination with cadmium it forms a rechargeable cadmium/mercury oxide cell which can be operated under hermetically sealed conditions. Since both electrodes are thermodynamically stable in aqueous alkaline electrolytes, the self discharge rate of the cell is very low and hence the Coulomb efficiency even at very low charge rates in the order of 1000 - 2000 hrs. is higher than 95%. The cadmium/mercury oxide cells can be cycled more than a hundred times. These cells are particularly qualified to serve as an energy storage in combination with photovoltaic cells. Author

N82-15530# Internationale Atomreaktorbau Gesellschaft, Bensberg (West Germany). Abt. Anlagenbau.
GAS COOLED SOLAR POWER PLANT FOR GENERATING ELECTRICAL ENERGY IN THE 20MWe OPERATING RANGE (GAST): PRELIMINARY DESIGN PHASE Final Report, Nov. 1980
Siegfried Kostrzewa and Peter Wehowsky Bonn Bundesministerium fuer Forschung und Technologie Jul. 1981 33 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-097; ISSN-0340-7608; IAT-BS-100000-010) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 7

R&D work required for the erection of a pilot plant was defined. Since the location of the site is not yet determined, the project work was based on preliminary basic data. Significant results of the preliminary design phase include both the choice of a combined gas/steam thermal energy conversion process for the reference concept and basic concepts for heliostat, heliostat field arrangement, receiver, tower and master control/process computer system. A.R.H.

N82-15532# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). New Energy Technology.
DEVELOPMENT OF A PROTOTYPE OF A 10 kW SMALL SOLAR POWER PLANT Final Report, Sep. 1979
Franz Maier and Josef Haenfling Bonn Bundesministerium fuer Forschung und Technologie Jun. 1981 170 p ref In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-101; ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 33.50

Activities performed in the design and construction of a solar driven 10 kW turbogenerator for local TV-educational systems, irrigation pumps and other applications in developing countries include: (1) System design and thermodynamic calculation; (2) Design of the collector array and construction; (3) Fixing of components and auxiliary units; (4) Turbine design, construction, manufacture and test run; (5) Generator design, construction, manufacture and test run; (6) Turbogenerator integration and test; (7) Electrical supply, plant control and regulation; and (8) Test assembly, performance and analysis. Component tests are being run and are being evaluated by a data acquisition unit installed on site. A.R.H.

N82-15534# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Inst. voor Chemische en Technologische Research.
SOLAR POWER SYSTEMS SMALLER THAN 500 W FOR MILITARY USE
P. P. M. M. Wittgen Nov. 1979 27 p refs In DUTCH; ENGLISH summary
(Contract A78/KL/125)
(PML-1980-06; TDCK-73397) Avail: NTIS HC A03/MF A01

A literature search of the feasibility of using photovoltaic cells for the energy supply of low power-consuming military equipment is presented. Progress in the technology of solar cells in the coming years offers good prospects for the use of photovoltaic systems. A hybrid system consisting of an array of solar cells combined with secondary batteries in a sunny climate is capable of supplying equipment with energy. Climatic conditions in the Netherlands and the northern part of Germany are too bad for a fully self-supporting year round system. Especially in winter the intensity and quantity of the radiation is too low. In these northern regions the hybrid solar system can only be used when additional primary or secondary batteries are accepted in the winter period. J.D.H.

N82-15537# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
ORGANIC FLUIDS FOR THE PRACTICAL USE IN ENERGY CONVERSION SYSTEMS OF SOLAR POWER PLANTS Final Report, Jun. 1980
Guenther Schmidt, Dietmar Wolf, and Eberhard Raasch Bonn Bundesministerium fuer Forschung und Technologie Sep. 1981 76 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-154; ISSN-0340-7608) Avail: NTIS HC A05/MF A01

With respect to their specific performance, the most promising organic fluids were determined for their practical use in Rankine cycles operating in the temperature range between 150 and 400 C. For these fluids, the process cycle efficiencies were compared for different temperature levels. Laboratory experiments with a great number of fluids and lubricants results in the estimation of the operation limit in Rankine Cycles. A test facility consisting of a heating system, an organic Rankine cycle and a control and measurement system was designed, built, and put into operation for testing various working fluids. Author

N82-15538# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
HIGH EFFICIENT COLLECTOR FOR SMALL SOLAR-POWERED FACILITIES Final Report
Eugen Obermayr, Wolfgang Molt, Dieter Schneller, and Klaus Speidel Bonn Bundesministerium fuer Forschung und Technologie Sep. 1981 100 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-156; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 21

A series of preliminary investigations and laboratory tests were performed as a basis for developing a new type of solar collector. The vacuum flat plate collectors are actually evaporators, where the working medium is evaporated within the collector itself. Prototypes of direct evaporation collectors were constructed and tested. In the temperature range seen for this application (130 - 150 C), the collector efficiency is about 40 - 50 percent. L.F.M.

N82-15541# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.
COMPARISON OF CONCEPTS FOR SOLAR-HEATED OR SOLAR-DRIVEN ABSORPTION AND COMPRESSION COOLING MACHINES FOR AIR CONDITIONING AND FOOD PRESERVATION PURPOSES, PHASE 1 Final Report, Nov. 1978
Herbert Grallert, Manfred Herbricht, and Martin Margulies Bonn Bundesministerium fuer Forschung und Technologie Sep. 1981 91 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-165; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 19.10

For the cooling power range of about 10 to 500 kW and for cooling temperatures of +20, 0, and -20 C, a comparison was made between solar heated absorption machines and compression machines, which are driven by a solar heated Rankine cycle. Comparison criteria are C.O.P., energy prices, and application risks. All partial efficiencies and costs were determinated by component analyses. For several cooling loads an annual system simulation was performed using MBB computer programs. Furthermore, the electric energy demand for absorption cooling systems was estimated and initial application recommendations are given. Author

N82-15544# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
LOW-COST PASSIVE-SOLAR RETROFITS FOR NEW AND EXISTING MOBILE HOMES
Steve Brant and Michael Holtz Jul. 1981 6 p refs Presented at the 6th AS/ISES Natl. Passive Conf., Portland, Oreg., 8-12 Sep. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-028356; SERI/TP-721-1138R; CONF-810925-17) Avail: NTIS HC A02/MF A01

Passive solar heating and cooling retrofit options can significantly reduce the energy consumption of new and existing mobile homes. The initial efforts of the Solar Energy Research Institute to explore the solar potential for the existing stock of mobile homes and those in the production stage are described. DOE

N82-15545# Midwest Research Inst., Golden, Colo.
INDUSTRIAL PROCESS HEAT APPLICATIONS FOR SOLAR THERMAL TECHNOLOGIES
David Feasby and David W. Kearney Jun. 1981 9 p refs Presented at the 3rd Intern. Conf. on Energy Use Management, West Berlin, 26 Oct. 1981
(Contract DE-AC02-77CH-00178)
(DE81-025934; SERI/TP-733-1278; CONF-811006-2) Avail: NTIS HC A02/MF A01

Selected solar industrial process heat (IPH) activities under development in the US are reviewed. Included are: a summary of the IPH field test program, status of solar thermal technologies, and results of specific technology/application matching and market studies. The near term viability of solar technologies in the industrial sector is dependent upon both the economic and technical issues which vary depending on the application, plant site, and system selected. DOE

N82-15551# Monsanto Research Corp., Dayton, Ohio.
LOW-COST MIRROR CONCENTRATOR BASED ON INFLATED, DOUBLE-WALLED, METALLIZED, TUBULAR FILMS Final Report
J. L. Schwendeman, G. L. Ball, III, J. W. Leffingwell, and C. E. McClung Jul. 1981 121 p refs
(Contract DE-AC04-78AL-04227)
(DE81-027813; MRC-DA-944; ALO-4227-6) Avail: NTIS HC A06/MF A01

A potentially low cost, inflatable plastic solar mirror concentrator based on segments of a cylinder joined along the length of the collector on a plane passing through the axis of the absorber tube was designed and built. This design results in a savings of approximately 40% in the amount of window and mirror material and in a savings of about 20% of the land area occupied by a single collector when compared to a fully cylindrical one. The type of construction permits the assembling of the mirror/window envelope to the collector without disturbing the collector frame, absorber tube, or the associated plumbing. Aluminum foil plastic laminates were used as an alternative to aluminized polyester films, because of their potential low cost and durability. Specially ultraviolet stabilized and polyester scrim reinforced flexible polyvinyl chloride film was developed for use as the outer cover material. DOE

N82-15563# Mid-American Solar Energy Complex, Minneapolis, Minn.
SOLAR ENERGY TRAINING PROGRAM FOR CODE ENFORCEMENT PERSONNEL
Jun. 1981 17 p
(Contract DE-AC02-79CS-30150)
(DE81-030053; MASEC-CF-81-023; P-101-12/A-101-4) Avail: NTIS HC A02/MF A01

A training program for building code officials is discussed. The development of a new model building code for solar was coordinated and course materials was developed. A manual to inform code officials about the basics of passive and active solar energy and the model code is developed Michigan was selected as the target state. DOE

N82-15564# Mid-American Solar Energy Complex, Minneapolis, Minn.
SUMMARY OF PASSIVE SOLAR MULTI-FAMILY DESIGN WORKSHOPS
Jun. 1981 14 p
(Contract DE-AC02-79CS-30150)
(DE81-030353; MASEC-CF-81-035; P-103-4) Avail: NTIS HC A02/MF A01

Instructional materials on the design, construction, and marketing of passive solar multi-family residential buildings were developed. An outline of the workbook used for the workshops is presented, along with a list of the workshops. Promotional activities are described briefly. DOE

N82-15569# Midwest Research Inst., Golden, Colo. Photoconversion Research Branch.
PHOTOELECTROCHEMICAL SOLAR CELLS: STABILIZATION OF SMALL-BAND-GAP SEMICONDUCTOR IN AQUEOUS SOLUTION BY SURFACE-ATTACHED ORGANIC CONDUCTING POLYMER
Arthur J. Frank Sep. 1981 13 p refs Presented at the Intern. Conf. on Low-Dimensional Conductors, Boulder, Colo., 10-14 Aug. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-030312; SERI/TP-233-1388; CONF-810864-1) Avail: NTIS HC A02/MF A01

Surface-attached polypyrrole films are shown to produce a marked improvement in the stability of n-type single-crystal and polycrystalline Si against oxidation in an aqueous electrolyte. The current production of n-type polycrystalline Si coated with polypyrrole deteriorates less than 30% during 122 hr of irradiation whereas the unprotected bare electrode stops producing photocurrent within 30 s. The polymer protection of the n-type single-crystal Si is significantly less than that of the polycrystalline material because of differences in the adhesion of the polymer film to the electrode surfaces. The adhesion strength is shown to depend on various surface properties of Si and other electrode materials. Moreover, the surface morphology of the electrode affects the topography of the growing surface of the polypyrrole film. Requirements are discussed for the applications of organic conducting polymers to photoelectrochemical devices utilized for solar energy conversion. DOE

N82-15571# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
COMPARATIVE THERMAL PERFORMANCE OF DIRECT GAIN, TROMBE, AND SUNSPACE WALLS
H. T. Ghaffari and R. F. Jones 1981 8 p refs Presented at the 6th Natl. Passive Conf., Portland, Ore., 8-12 Sep. 1981 sap
(Contract DE-AC02-76CH-00016)
(DE81-030546; BNL-29970; CONF-810925-21) Avail: NTIS HC A02/MF A01

The natural thermal storage features of the Brookhaven superinsulated house were analyzed and verified. These include the Trombe and sunspace passive-solar-collection walls and the superinsulated south-facing wall. The thermal contributions of each system were demonstrated. Several thermal characteristic factors, in relation to each design for the hourly and daily period, were assessed. Further, the interior temperature fluctuations and the reductions in the required auxiliary energy with regard to incorporated passive designs were evaluated. T.M.

N82-15572# Department of Energy, Washington, D. C. Office of the Assistant Secretary for Conservation and Renewable Energy.
ANNUAL DOE ACTIVE SOLAR HEATING AND COOLING CONTRACTORS REVIEW MEETING
Sep. 1981 286 p refs Proc. of Conf. held in Washington, D.C., Sep. 1981
(DE81-028052; CONF-810912) Avail: NTIS HC A13/MF A01

Ninety three project summaries dicussing the following aspects of active solar heating and cooling are presented: Rankine solar cooling systems; absorption solar cooling systems; desiccant solar cooling systems; solar heat pump systems; solar hot water systems; special projects (such as the National Solar Data Network, hybrid solar thermal/photovoltaic applications, and heat transfer and water migration in soils); administrative/management support; and solar collector, storage, controls, analysis, and materials technology. DOE

N82-15575# California Univ., Berkeley. Lawrence Berkeley Lab.
INCREMENTAL COOLING LOAD DETERMINATION FOR

PASSIVE DIRECT GAIN HEATING SYSTEMS
Paul W. Sullivan, Douglas Mahone, Winslow Fuller, James Gruber, Ron Kammerud, Wayne Place, and Brandt Anderson May 1981 5 p refs Presented at the Am. Sect. of the Intern. Solar Energy Soc., Philadelphia, 27-30 May 1981
(Contract W-7405-eng-48)
(DE81-029882; LBL-12048; CONF-810509-40) Avail: NTIS HC A02/MF A01

The applicability of the National Association of Home Builders (NAHB) full load compressor hour method for predicting the cooling load increase in a residence attributable to direct gain passive heating systems is examined. The NAHB method predictions are compared with the results of 200 hour-by-hour simulations using BLAST, and the two methods show reasonable agreement. The degree of agreement and the limitations of the NAHB method are discussed. DOE

N82-15576# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SERI SOLAR-ENERGY-STORAGE PROGRAM
Charles E. Wyman Aug. 1981 3 p refs Presented at the Ann. DOE Active Solar Heating and Cooling Contractors Rev. Meeting, Washington, D.C., 14-16 Sep. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-029476; SERI/TP-620-1344; CONF-810912-11) Avail: NTIS HC A02/MF A01

The program provides research, system analysis, and assessments of thermal energy storage and transport in support of the Thermal Energy Storage Program of the DOE Division of Energy Storage Technology; emphasis is on thermal energy storage for solar thermal power and process heat applications and on thermal energy transport. Currently, research is in progress on direct-contact thermal energy storage and thermochemical energy storage and transport. In addition, SERI is directing the definition of new concepts for thermal energy storage and supporting research on thermal energy transport by sensible and latent heat media. SERI is performing systems analyses of thermal energy storage for solar thermal application and coordinating thermal energy storage activities for solar applications. DOE

N82-15577# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
OVERVIEW OF ACTIVE SOLAR ABSORPTION/RANKINE COOLING PROGRAM
Michael Wahlig, Al Heitz, Harry Angerman, Ron Glas, and Mashuri Warren Jul. 1981 7 p Presented at the Active solar Contractors' Review Meeting, Washington, D.C. 9-12 Sep. 1981; sponsored by DOE
(Contract W-7405-eng-48)
(DE81-028041; LBL-13054-Rev; CONF-810912-13) Avail: NTIS HC A02/MF A01

The individual absorption and Rankine projects along with the main features and accomplishments/status of each and future plans were identified. The absorption program, was three active component development projects, four systems field test projects, one advanced fluid study project and one advanced cycle study project. Rankine program, includes five active component development projects, two system field test projects, and one advanced study project. DOE

N82-15578# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
VERIFICATION OF BLAST BY COMPARISON WITH MEASUREMENTS OF A SOLAR-DOMINATED TEST CELL AND A THERMALLY MASSIVE BUILDING
Brandt Andersson, Fred Bauman, William Carroll, Ronald Kammerud, and Nina Friedman Apr. 1981 12 p refs Presented at the 3rd Ann. Systems Simulation and Econ. Anal. Operational Results Conf., Solar Energy Div., Reno, Nev., 27 Apr. - 1 May 1981; sponsored by ASME
(Contract W-7405-eng-48)
(DE81-029883; LBL-11387; CONF-810405-16) Avail: NTIS HC A02/MF A01

Temperatures were compared in a direct solar gain test cell and temperatures were predicted. The comparisons were performed for two distinct climate period. The test cell configuration and weather data manipulations, quantitative evaluations of the comparisons between measured and predicted interior temperatures, limitations of the comparisons, and sensitivities of the simulation results to uncertainties in the measured parameters are examined. In the second study, comparisons of BLAST predictions to temperatures and loads measured in a massive structure were carried out. The tests verifying the program's ability to: (1) calculate full scale building loads; and (2) accurately model hybrid cooling using forced ventilation. DOE

N82-15581# Los Alamos Scientific Lab., N. Mex.
USE OF OXIDE DECOMPOSITIONS IN ADVANCED THERMOCHEMICAL HYDROGEN CYCLES FOR SOLAR HEAT SOURCES. APPLICATION OF THE TRICOBALT TETRAOXIDE-COBALT MONOXIDE PAIR
W. M. Jones and M. G. Bowman 1981 9 p refs Presented at Intern. Energy Agency Annex 1 Workshop on Thermochem. Hydrogen, Julich, West Germany, 23 Sep. 1981
(DE81-030235; LA-UR-81-2628; CONF-810942-6) Avail: NTIS HC A02/MF A01

The concept of utilizing oxide decompositions in advanced thermochemical hydrogen cycles for solar heat sources is introduced. It allows direct transmission of energy to the process through an air window. Reaction (2) gives a high concentration of MgI2 that would be favorable for (3). The solutions contain iodine dissolved as polyiodide, partly offsetting this advantage. It is indicated that reaction (2) is slow at 150 C. It is surmised that the mechanism of (2) consists of the iodine disproportionation reaction (6), followed by reaction (7). It was found that (6) was relatively fast and with a good yield at 150 C. Reaction (7) is sufficiently slow at 150 C to account for the slowness of (2). The yield of (7) is proportional to the square root of the time, suggesting that iodate must diffuse through an adherent, accumulating C0304 layer. DOE

03
HYDROGEN

Includes hydrogen production, storage, and distribution.

A82-10398 Hydrogen generation by means of catalyzed Mg-Al hydrolysis. K. Höhne and P. Jäger (Siemens AG, Forschungslaboratorien, Erlangen, West Germany). *Siemens Forschungs- und Entwicklungsberichte*, vol. 10, no. 5, 1981, p. 323-326. 5 refs.

Based on considerations of reactivity, costs, and the volume of hydrogen which can be expected per mass fraction of metal, Al and Mg offer good possibilities in metal hydrolysis. Since these metals hardly react with water, however, a catalyst is used to accelerate the Mg-Al hydrolysis process. Experiments show that a mixture of Mg and Al reacts strongly with water in the presence of CO3O4, MoO3, and Cl-ions; with an optimum combination of all the participants in the reaction, the H2 yield can amount to 100%. Various methods are discussed for constructing a hydrogen generator using this new method of metal hydrolysis. A hydrogen generator plant is described, in which pressed powder pellets are used. An aluminum-magnesium-cobalt oxide powder mixture is introduced into the reactor in the form of cylindrical pellets, which are pulverized in the reactor chamber. The powder falls into the salt water in the reactor and is converted. The hydrogen produced has a purity potentially greater than 99.9%. J.F.

A82-10966 # A LH2 engine fuel system on board - Cold GH2 injection into two-stroke engine with LH2 pump. S. Furuhama (Musashi Institute of Technology, Tokyo, Japan), Y. Kobayashi, and M. Iida. *American Society of Mechanical Engineers and American Institute of Chemical Engineers, National Heat Transfer Conference, 20th, Milwaukee, WI, Aug. 2-5, 1981, ASME Paper 81-HT-81.* 10 p. 14 refs. Members, $2.00; nonmembers, $4.00.

An LH2-tank with a range of 400 km was installed in the rear trunk of a small passenger car in June, 1980. Tests demonstrated the overall feasibility of a hydrogen-fueled car: the tank attained a maximum power 20% to 20% higher than its gasoline counterpart and about twice as high as those of premixed engines. There was no backfire or knocking, and a very low NOx emission level was achieved by injecting -30 to -50 C cold hydrogen gas, pressurized by an LH2-pump, into the two-stroke engine. The LH2-pump was developed by the Musashi Institute of Technology; the barrel and the plunger are made of metal and a durable, low friction material, respectively. The plunger clearance was reduced to about 3 microns under operating conditions, thereby making fuel leakage from the plunger clearance negligible. Proper tank pressures were obtained according to the pump speed. The maximum speed of the car was recorded at 135 km/h. Future objectives include the production of an engine with a higher compression ratio through the development of a high pressure pump having a discharge pressure above 6 MPa, and the improvement of the heat insulation performance of the LH2-tank. J.F.

A82-10988 # Liquid hydrogen for automotive vehicles - Experimental results. W. Peschka (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Technische Physik, Vaihingen, West Germany). *American Society of Mechanical Engineers and American Institute of Chemical Engineers, National Heat Transfer Conference, 20th, Milwaukee, WI, Aug. 2-5, 1981, ASME Paper 81-HT-83.* 14 p. 21 refs. Members, $2.00; nonmembers, $4.00.

A BMW-518 has been adapted for LH2-fuel, representing the first LH2-fueled car in Europe. This is a joint program between the German Research and Testing Laboratory for Aeronautics and the Research Institute for Motor-Transport Service and Automotive Engines at the University of Stuttgart. The program was established for demonstration of successful car-operation and and the safe handling of LH2-fuel during car operation and refueling. Based on earlier papers, more recent test results and experiences are reported about car operation and engine performance. The car has been driven over an accumulated distance of about 1800 km on a test track. The test track consists of a loop of about 2.5 km in length, including a proper combination of straight level sections, curved sections and ascending sections. In order to demonstrate a safe liquid hydrogen refueling procedure that could also be used by untrained people, a semiautomatic computer operated refueling station has been developed. This refueling station is in successful operation. (Author)

A82-11784 # Improved efficiency in the sulfur dioxide - iodine hydrogen cycle through the use of magnesium oxide. C. F. V. Mason and M. G. Bowman (California, University, Los Alamos, NM). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1411-1414. 10 refs. Research sponsored by the U.S. Department of Energy.

The reaction of iodine with dry magnesium oxide and magnesium sulfite hexahydrate was studied experimentally as a possible means of improving the efficiency of the sulfur dioxide-iodine cycle. When no extra water was introduced, the maximum product yield was 67% obtained at 423 K. With excess water vapor, a nonporous plug was formed which prevented complete reaction. In the second case, maximum yield was 62% measured at 423 K showing that added water does not increase reaction products. This reaction gives an alternate route for producing hydrogen from water via the sulfur dioxide-iodine process. (Author)

A82-11785 # Parametric study of the cadmium thermoelectrochemical hydrogen cycle. J. D. Schreiber and R. H. Carty (Institute of Gas Technology, Chicago, IL). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1415-1419. 21 refs.

Hydrogen production by thermochemical water-splitting has been proposed as an energy conversion process for using heat to produce a chemical fuel, hydrogen, from water. One cyclic process of this type is based on the high-temperature thermal decomposition of cadmium oxide. To be efficient, this chemically simple cycle requires about 75% of its total energy input as nearly isothermal heat above 1500 K to drive the CdO decomposition step. It appears, therefore, to be ideal for an employment in conjunction with a solar heat source capable of supplying nearly isothermal heat. Attention is given to the electrochemistry oxidation of cadmium, the thermal decomposition of cadmium hydroxide, and the thermal decomposition of cadmium oxide. A description is given of a flow sheet analysis, taking into account evaluation studies conducted with the aid of a computer program. G.R.

A82-11786 # Alkaline solution water electrolysis - '81. J. N. Murray (Teledyne Energy Systems, Timonium, MD). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1420-1424. 8 refs. Research supported by the U.S. Department of Energy.

During the last two years several improvements in the alkaline solution electrolysis technology have been implemented in form of practical hardware. Attention is given to the catalyst system 'C-AN', alternative anode structures, a new proprietary anode electrocatalyst, alternates to the conventional chrysotile asbestos separator, the current status of hardware development, and the employment of simplistic and complex models for establishing the economics of hydrogen via water electrolysis. G.R.

A82-11787 # Development status of the General Electric solid polymer electrolyte water electrolysis technology. L. J. Nuttall (General Electric Co., Wilmington, MA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1425-1429.

The solid polymer electrolyte used by the considered technology is a thin sheet (5 to 10 mil thickness) of a sulfonated fluoropolymer. It is a high strength plastic material which serves as the sole electrolyte, and also forms a rugged barrier between the hydrogen and oxygen chambers. The electrodes consist of a thin catalyst layer bonded to the surfaces of the plastic sheet. A

description is presented of a 60-cell module, operating at the normal design point of 1000 amps per square foot. The module generates more than 2000 standard cubic feet per hour of hydrogen at a pressure of approximately 100 psig. Performance and cost projections are discussed. G.R.

A82-11788 # Solar hydrogen system design considerations. S. Lin, G. H. Parker, and M. E. Stella (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1430-1435.

Attention is given to the Sulfur Cycle, a hybrid thermochemical-electrochemical process for the production of hydrogen and oxygen from water. The process, in its most general form, consists of two chemical reactions. The net result of the process is the decomposition of water into hydrogen and oxygen. The sulfur oxides are involved solely as recycling intermediates. The electrical power needed is much smaller than the power required in conventional water electrolysis. A description of the pressurized test unit is provided, and an investigation is conducted of key process variables. G.R.

A82-11790 # Lightweight hydrides for automotive storage of hydrogen. D. A. Rohy, J. F. Nachman, and T. A. Argabright (Solar Turbines International, San Diego, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1446-1448. Research supported by the U.S. Department of Energy.

The primary objectives of the considered investigations are related to the reduction of the dissociation temperature of lightweight materials, and the development of new lightweight hydrides containing little, if any, critical material. Attention is given to the characteristics of metal hydrides, the characteristics of a magnesium-base alloy which is to be employed in hydrogen storage systems for automobiles, aspects of alloy development, and the evaluation of magnesium hydride alloys with the aid of a hydride cycling rig. New information concerning the effect of cycling on magnesium alloys is discussed. G.R.

A82-11791 # A study of factors influencing thermally induced backfiring in hydrogen fueled engines, and methods for backfire control. C. A. MacCarley (Denver, University, Denver, CO). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1449-1453. 12 refs.

As an I.C. engine fuel, hydrogen offers the advantages of no carbon compound exhaust emissions and high thermal efficiency. However, the problems of intake manifold backfire and decreased engine power output have been obstacles to automotive hydrogen use. Thermal causes of backfiring are investigated using a Cooperative Fuel Research engine and an electronically controlled, timed fuel injection system. Correlation of backfiring and injection timing are reported. It is concluded that both maintenance of low average in-cylinder temperatures and the use of some means for timed, delayed fuel delivery are essential to achieving backfire-free operation under all conditions. A mechanical timed port injection system incorporating air flow controlled fuel metering is described as a means for providing delayed fuel delivery with variable injection timing. Data are presented on the performance of a 2.6 liter, 4 cylinder engine using this system in naturally aspirated and turbocharged configurations. (Author)

A82-11792 # Small-scale uses and costs of hydrogen derived from OTEC ammonia. G. Strickland (Brookhaven National Laboratory, Upton, NY). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1459-1467. 32 refs. Research sponsored by the U.S. Department of Energy.

Ocean Thermal Energy Conversion (OTEC) plantships could produce NH3 from air and water, using energy derived from thermal gradients in tropical oceans. NH3 can serve both as a commodity, for the fertilizer and chemical industries, and as a liquid energy carrier for fuel use. Attention is given to the economic prospects for using OTEC NH3 as a hydrogen transport and storage medium for small users who want to assess the purchase of hydrogen vs. the cost of producing hydrogen at their sites. Hydrogen is readily obtained from NH3 at the point of end use, by dissociation and purification as required, for use as a chemical commodity or fuel. It is shown that high-purity H2 derived from OTEC NH3 might be competitive with H2 made at the point of end use via water electrolysis, or via steam reforming of natural gas. G.R.

A82-11844 * # The GA sulfur-iodine water-splitting process - A status report. G. E. Besenbruch, H. D. Chiger, K. H. McCorkle, J. H. Norman, J. S. Rode, J. R. Schuster, and P. W. Trester (General Atomic Co., San Diego, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2143-2147. Research supported by the Gas Research Institute, Metal Properties Council, and General Atomic Co.; Contracts No. DE-AC02-80ET-26225; No. JPL-955263.

The development of a sulfur-iodine thermal water splitting cycle is described. The process features a 50% thermal efficiency, plus all liquid and gas handling. Basic chemical investigations comprised the development of multitemperature and multistage sulfuric acid boost reactors, defining the phase behavior of the HI/I2/H2O/H3PO4 mixtures, and development of a decomposition process for hydrogen iodide in the liquid phase. Initial process engineering studies have led to a 47% efficiency, improvements of 2% projected, followed by coupling high-temperature solar concentrators to the splitting processes to reduce power requirements. Conceptual flowsheets developed from bench models are provided; materials investigations have concentrated on candidates which can withstand corrosive mixtures at temperatures up to 400 deg K, with Hastelloy C-276 exhibiting the best properties for containment and heat exchange to I2. M.S.K.

A82-16346 Halogen acid electrolysis in solid polymer electrolyte cells. E. N. Balko, J. F. McElroy, and A. B. LaConti (General Electric Co., Wilmington, MA). *International Journal of Hydrogen Energy*, vol. 6, no. 6, 1981, p. 577-587. 27 refs.

The use of solid polymer electrolyte systems has been extended to the electrolysis of aqueous HCl and HBr. The reduced internal losses in these cells permits the production of hydrogen and the halogen at an energy consumption considerably less than that reported previously. Data are presented for the operational characteristics of the solid polymer electrolyte acid electrolysers operating over a range of current densities, pressures, feedstock compositions, and temperatures. (Author)

A82-16347 Mechanically stable hydride composites designed for rapid cycling. E. E. Eaton, C. E. Olsen, H. Sheinberg, and W. A. Steyert (Los Alamos National Laboratory, Los Alamos, NM). *International Journal of Hydrogen Energy*, vol. 6, no. 6, 1981, p. 609-623. 18 refs.

A number of porous composites were prepared by combining LaNi5 with copper, aluminium, lead-tin solder, lead, and polyurethane. The preparation methods, hydrogen absorption, electrical and thermal conductivities, and kinetics of these mechanically stable, machinable composites are reported. (Author)

A82-16734 Technological innovation for success - Liquid hydrogen propulsion. J. L. Sloop (International Consultants on Energy Systems, Bethesda, MD). In: Between Sputnik and the Shuttle - New perspectives on American astronautics. San Diego, CA, Univelt, Inc., 1981, p. 225-239. 23 refs.

Hydrogen produces the highest exhaust velocity of all chemical fuels, thus producing the highest rocket velocities, but also has a low density, only one-quarter that of water. The development of hydrogen as a rocket fuel was begun in the early 1900s, though experiments were few due to the difficulty of obtaining liquid hydrogen. Para- and orthohydrogen were discovered in 1926, and catalysts to prevent the natural conversion of para to ortho, which tended to boil away liquefied hydrogen, were invented in the 1950s. Rocket testing using liquid hydrogen began in the 1940s, and the demand for liquid hydrogen increased for testing of thermonuclear

weapons, although the supply of LH did not grow until the possibility for its use as a fuel for high altitude reconnaissance planes was investigated. Once NASA was created, the progress of an LH fueled stage for the Atlas rocket accelerated LH research, and led to NASA control of the development of the Saturn CV launch vehicle. An alternative use of liquid hydrogen as an automotive fuel is indicated. M.S.K.

A82-16784 Metal hydrides 1980; Proceedings of the International Symposium on the Properties and Applications of Metal Hydrides, Colorado Springs, CO, April 7-11, 1980. Volumes 1 & 2. Symposium sponsored by the U.S. Department of Energy, MPD Technology Corp., and Sandia National Laboratory. Edited by G. G. Libowitz (Allied Chemical Corp., Morristown, NJ) and G. D. Sandrock (Inco Research and Development Center, Suffern, NY). Lausanne, Elsevier Sequoia, S.A., 1980. Vol. 1, 395 p.; vol. 2, 485 p. Price of two volumes, $165.

Papers were presented on the thermodynamics, kinetics, and surface effects of hydrides, in addition to nuclear magnetic resonance and Mössbauer studies. Attention was also given to hydrides of Laves-phase intermetallics and superconductivity in hydrides. Crystal structures and phase relations in hydrides were examined, as were the physical and electronic properties of various hydrides and their band structure. The general theory of hydrides was explored, and further notice was made of miscellaneous hydride systems, applications of hydrides, and the behavior of hydrogen in metals. M.S.K.

A82-17129 Hydrogen from solar energy (Wasserstoff aus Sonnenenergie). W. Schnurnberger, W. Seeger, and H. Steeb (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *DFVLR-Nachrichten,* Nov. 1981, p. 11-15. In German.

It is expected that, at some time in the foreseeable future, processes for obtaining hydrogen on the basis of a use of nonfossil energy will be economically feasible. Nonfossil energy sources considered are related to water power, nuclear energy, and solar energy. The current status of various approaches for the decomposition of water is examined, taking into account a supply of the required energy in form of heat, electric power, or light energy. At the present time only the technology of water electrolysis is sufficiently advanced to provide hydrogen on a large scale. Considerable improvements regarding current electrolysis technology with respect to efficiency and required capital costs should be possible within the foreseeable future. Approaches are considered to obtain the required electric power for the electrolysis with the aid of processes based on the utilization of solar cells. Attention is given to improved procedures for water electrolysis, and approaches for achieving optimal operational relations between solar-cell generators and electrolysis equipment. G.R.

A82-17130 The storage of hydrogen (Zur Wasserstoff-Speicherung). C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *DFVLR-Nachrichten,* Nov. 1981, p. 15-22. In German.

It is pointed out that a storage of hydrogen with the aid of conventional methods is technically feasible, taking into account the storage of hydrogen as a gas at higher pressures and its storage as a liquid. On the basis of the currently foreseeable production costs for hydrogen, an employment of conventional storage procedures appears acceptable. There are, in addition to the conventional methods, also a number of novel concepts for hydrogen storage. However, the practical feasibility of an employment of these concepts in connection with hydrogen production and distribution systems has still to be demonstrated. A brief description is presented of the conventional storage procedures. In connection with a discussion of the novel concepts, attention is given to a storage of hydrogen in the form of metal hydrides and approaches to store hydrogen with the aid of materials which adsorb it at low temperatures (60 to 100 K). A comparative study concerning the economics of the various storage procedures is also conducted. G.R.

A82-17131 The generation of current from hydrogen (Stromerzeugung aus Wasserstoff). H. J. Sternfeld, H. Wojkowsky, and K. Wolfmüller (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für chemische Antriebe und Verfahrenstechnik, Lampoldhausen, West Germany). *DFVLR-Nachrichten,* Nov. 1981, p. 22-26. In German.

Factors regarding the storage of electrical energy and approaches to meet peak loads demands will become increasingly important in the future. A chemical storage of electrical energy in the form of hydrogen appears to offer a suitable approach to satisfy requirements related to these trends. For an implementation of such an approach, it will be necessary to solve the problem of an economical generation of electrical power from hydrogen. Procedures for such a generation of electric power can be divided into two categories, which are related to a use of fuel cells and an employment of steam or gas turbine processes. Suitable fuel cells can be based on a use of hydrogen and oxygen or an employment of hydrogen and air. The use of the power generation procedures of the second category involves a primary transformation of the chemical energy of the fuel into heat. A description is presented of an evaluation study regarding the different types of power stations. Attention is given to a possible technological employment of steam generators based on the use of hydrogen and oxygen in the 1980's. G.R.

A82-17132 Aspects concerning the safety of hydrogen (Sicherheitsaspekte des Wasserstoffs). M. Fischer and H. Eichert (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *DFVLR-Nachrichten,* Nov. 1981, p. 33-37. In German.

Questions regarding the safety of operations and processes involving hydrogen arise in connection with the envisaged employment of hydrogen in a global energy system. A description is presented of an investigation in which physical-chemical characteristics and safety-technological parameters of hydrogen are compared with the corresponding data for methane and gasoline. An examination of the environmental effects related to a use of hydrogen as fuel shows that there are no pollutants in the case of terrestrial applications. The effects of an introduction of certain amounts of water vapor into the higher layers of the atmosphere would have to be considered in connection with an employment as aircraft fuel. Attention is given to ignition limits, the energy required for ignition, the combustion rate, density, ignition temperature, the diffusion coefficient, deflagration, detonation, storage, transportation, safety aspects regarding liquid hydrogen, experience related to an employment of hydrogen, hydrogen embrittlement, and further research required with respect to some aspects of safety technology. G.R.

A82-17150 Rechargeable metallic hydrides for hydrogen storage. H. C. Angus (MPD Technology, Ltd., Birmingham, England). *Physics in Technology,* vol. 12, Nov. 1981, p. 245-250, 257. 5 refs.

The principles and methods of storing hydrogen in solid form in hydrides are examined. Hydrogen at certain temperatures and pressures is absorbed in large quantities by ternary hydride alloys, usually composed of Ti, Li, or Mg, with Fe and Ni. Decreasing pressures, such as occur when the hydrogen gas is released, allow the flow of hydrogen from the solid. A plateau pressure is defined for the amount of heat required to 'fill' the hydride, and which is specific for each alloy. Properties of thermal conductivity, specific heat, the ability to absorb impurities, and volume change during hydriding affect the suitability of the hydriding material, and it is noted that most hydrides are brittle and must be chosen to not collapse into a powder during hydriding. Various hydrogen storage configurations are mentioned, with the largest static store now weighing a ton. M.S.K.

A82-17290 Liquid hydrogen - An outstanding alternate fuel for transport aircraft. W. M. Hawkins. In: Safe and efficient management of energy; Proceedings of the Thirty-third Annual International Air Safety Seminar, Christchurch, New Zealand, September 15-18, 1980. Arlington, VA, Flight Safety Foundation, Inc., 1980, p. 270-295.

Liquid hydrogen is proposed as an excellent alternate aircraft fuel, owing to its worldwide availability, low cost, ability to be transported and stored without difficulty, and minimum impact on the environment. NASA compared the characteristics and performance of three aircraft using (1) synthetic Jet A, (2) liquid methane, and (3) liquid hydrogen. The liquid hydrogen aircraft was found to weigh considerably less than the others, thereby reducing the take-off gross weight. Every pound of hydrogen produces 51,500 BTU's, whereas a pound of Jet A produces only 18,400 BTU's.

Moreover the liquid hydrogen aircraft uses the least energy in spite of aerodynamic disadvantages of the aircraft and high energy needs for liquefaction and the manufacturing process. Liquid hydrogen also has a fly-over noise level of 89 decibels compared to the 94 decibels for the Synjet aircraft. A simple system of laminar flow maintenance using liquid hydrogen is discussed, and several safety features of the fuel are noted. J.F.

A82-18392 Thermochemical processes for hydrogen production by water splitting - From theory to practice. G. De Beni (Commission of the European Communities, Joint Research Center, Ispra, Italy). *(Electrochemical Society Meeting, Hollywood, FL, Oct. 5-10, 1980.) Electrochemical Society Journal*, vol. 129, Jan. 1982, p. 67-72. 27 refs.

Theoretical energy requirements for water splitting are well known. The values of Delta-H and Delta-S of 'ideal' chemical reactions suitable for thermochemical cycles can be computed. The chemists, however, must work with 'real' reactions. The constraints and the problems due to the 'nonideality' of reactions are discussed. These problems are: incertitude of thermodynamic data and phase diagrams; separation of excess water and other chemical products; low temperature side of the cycles; materials of construction, heat exchanges and heat coupling with available heat source. (Author)

N82-11223*# National Aeronautics and Space Administration, Washington, D. C.
TECHNICAL AND ECONOMIC ASPECTS OF HYDROGEN STORAGE IN METAL HYDRIDES
R. Schmitt Sep. 1981 44 p refs Transl. into ENGLISH from Proc. of the Intern. Workshop on Hydrogen and its Perspectives, v. 1, Liege, 1976 p 1-48 Presented at the Intern. Workshop on Hydrogen and its Perspectives, Liege, 15-18 Nov. 1976 Original language document was announced as A78-18842 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Battelle Memorial Inst., Geneva
(Contract NASw-3198)
(NASA-TM-76610) Avail: NTIS HC A03/MF A01 CSCL 21D

The recovery of hydrogen from such metal hydrides as LiH, MgH2, TiH2, CaH2 and FeTiH compounds is studied, with the aim of evaluating the viability of the technique for the storage of hydrogen fuel. The pressure-temperature dependence of the reactions, enthalpies of formation, the kinetics of the hydrogen absorption and desorption, and the mechanical and chemical stability of the metal hydrides are taken into account in the evaluation. Economic aspects are considered. Development of portable metal hydride hydrogen storage reservoirs is also mentioned. Author

N82-11225*# National Aeronautics and Space Administration, Washington, D. C.
THE STORAGE OF HYDROGEN IN THE FORM OF METAL HYDRIDES: AN APPLICATION TO THERMAL ENGINES
C. Gales (Comm. a l'Energie Atomique, Centre d'Etudes Nucl. de Grenoble) and P. Perroud (Comm. a l'Energie Atomique, Centre d'Etudes Nucl. de Grenoble) Aug. 1981 39 p refs Transl. into ENGLISH from Proceedings of the Assoc. des Ingr. Electriciens sortis de L'Inst. Electrotech. Montefiore, Belgium, v. 1, 1977 p 1-34 Conf. held at Liege, Belgium, 15-18 Nov. 1976 Original language document was announced as A78-18845 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-3199)
(NASA-TM-76609) Avail: NTIS HC A03/MF A01 CSCL 21D

The possibility of using LaNi56, FeTiH2, or MgH2 as metal hydride storage sytems for hydrogen fuelad automobile engines is discussed. Magnesium copper and magnesium nickel hydrides studies indicate that they provide more stable storage systems than pure magnesium hydrides. Several test engines employing hydrogen fuel have been developed: a single cylinder motor originally designed for use with air gasoline mixture; a four-cylinder engine modified to run on an air hydrogen mixture; and a gas turbine. S.L.

N82-11257# Brookhaven National Lab., Upton, N. Y.
FUSION AS A SOURCE OF SYNTHETIC FUELS
J. R. Powell, J. A. Fillo, and M. Steinberg 1981 10 p refs Presented at the Energy in the Man-Built Environ.: The Next Decade Specialty Conf., Vail, Colo., 3 Aug. 1981
(Contract DE-AC02-76CH-00016)
(BNL-29281; CONF-810808-2) Avail: NTIS HC A02/MF A01

Efficient production of hydrogen-based fuels from fusion is addressed. Water splitting reactions discussed include high temperature electrolysis of steam, thermochemical cycles, hybrid electrochemical/thermochemical, and direct thermal decomposition. High temperature electrolysis appears to be the simplest and most efficient process with efficiencies of 50 to 70% (Fusion to hydrogen chemical energy), depending on process conditions. DOE

N82-11262# Los Alamos Scientific Lab., N. Mex.
HYDROGEN STORAGE-BED DESIGN FOR TRITIUM SYSTEMS TEST ASSEMBLY
Hatice S. Cullingford, Michael G. Wheeler, and John W. McMullen 1981 18 p refs Presented at the Intern. Symp. on Metal-Hydrogen Systems, Miami Beach, Fla., 13-15 Apr. 1981
(Contract W-7405-eng-36)
(DE81-025336; LA-UR-81-1906; CONF-810497-1) Avail: NTIS HC A02/MF A01

The Los Alamos National Laboratory complete the design of a hydrogen storage bed for the Tritium Systems Test Assembly (TSTA). Our objective is to store hydrogen isotopes as uranium hydrides and recover them by dehydriding. The specific use of the storage bed is to store DT gas as U(D,T)3 when it is required for the TSTA. The hydrogen storage bed consists of a primary container in which uranium powder is stored and a secondary container for a second level of safety in gas confinement. The primary container, inlet and outlet gas lines, cartridge heaters, and instrumentation are assembled in the secondary container. The design of the hydrogen storage bed is presented, along with the modeling and analysis of the bed behavior during hydriding-dehydriding cycles. DOE

N82-12266# Chemische Werke, Huels (West Germany). Marketforschung.
ASSESSMENT OF POTENTIAL FUTURE MARKETS FOR THE PRODUCTION OF HYDROGEN FROM WATER Final Report
Helmut Kalenda and Gerhard Ruckelshauss Bonn Bundesministerium fuer Forschung und Technologie Jan. 1981 232 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-012; ISSN-0340-7608) Avail: NTIS HC A11/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 39,60

The market potential of hydrogen as a chemical raw material and a secondary energy carrier in the Federal Republic of Germany was assessed for various market sectors for the period from 1985 to 2025. The present status of research and technology is depicted. The hydrogen demand in the market sectors of chemistry, petroleum refining industry, steel production, energy, and transport are assessed. Hydrogen production costs for different actual and future technologies are asessed and compared with the production of competing energy carriers, including nuclear high temperature heat. The anticipated demand of hydrogen, broken down according to market sectors is given for the years 1985, 2005 and 2025, taking into account the development of the national and global energy demand. Eight technologies for the production of hydrogen and four technologies for the production of synthetic natural gas are compared, both technically and economically. Hydrogen from high temperature electrolysis of steam is expected to enter the market as a competitive energy carrier not before 2015 to 2025. Author (ESA)

N82-14382# Brookhaven National Lab., Upton, N. Y.
DEVELOPMENT OF A METAL HYDRIDE PROCESS FOR HYDROGEN RECOVERY FROM SUPPLEMENTED NATURAL GAS
F. Reidinger and F. B. Hill 1981 6 p refs Presented at the 2nd World Congr. of Chem. Engr., Montreal, Canada, 4 Oct. 1981
(Contract DE-AC02-76CH-00016)
(DE81-022685; BNL-29461; CONF-811007-4) Avail: NTIS HC A02/MF A01

A metal hydride hydrogen recovery process which has commercially attainable pretreatment requirements, a thermal reactivation procedure with temperatures not exceeding 500 C with reactivation rquired at intervals of 100 absorption desorption cycles, and an alloy lifetime of the order of 70,000 cycles is described. Mercaptan-alloy interactions are considered. The

interaction of CO with the alloy in the presence of hydrogen appears quite complicated. The present work indicates that CO 2 concentrations up to 500 ppM may have negligible effect on the rate of hydrogen absorption after an initial exposure to CO2 and hydrogen. If a slower hydrogen sorption rate can be toierated then higher CO2 levels may be acceptable. DOE

N82-15220# Brookhaven National Lab., Upton, N. Y. Dep.. of Energy and Environment.

SYSTEMS ANALYSIS OF HYDROGEN/NATURAL GAS SUPPLEMENTATION AND SEPARATION

M. Beller, J. DAcierno, and A. Hermalee Apr. 1981 6 p refs Presented at the 2nd World Congr. of Chem. Eng., Montreal, Oct. 1981

(Contract DE-AC02-76CH-00016)

(DE81-021383; BNL-29520; CONF-811007-5) Avail: NTIS HC A02/MF A01

Specific potential markets for hydrogen are investigated and then examines the mix of customers comprising these markets. The pipeline infrastructure, its capability for use to store and transmit hydrogen, and the incentives and drawbacks in this area are studied. There is sufficient use of both hydrogen and natural gas in potential hydrogen-consuming industries to overcome the problem of reinjection of natural gas into the pipeline after separation. DOE

N82-15231# Futures Group, Glastonbury, Conn.

AN ASSESSMENT OF NONFOSSIL HYDROGEN Final Report

E. Fein and T. Munson Dec. 1980 221 p refs Prepared for Gas Research Inst.

(GRI Proj. 50 14-310-0274)

(PB81-246522; GRI-79/0108) Avail: NTIS HC A10/MF A01 CSCL 21D

The potential for hydrogen produced from nonfossil energy sources as an energy carrier is examined. Water electrolysis, thermochemical systems, and various solar radiation processes are evaluated as hydrogen production methods. Long-term and short-term hydrogen storage technologies were also considered. Various possible hydrogen end-uses were appraised, including its role as an industrial chemical, a heating fuel for stationary applications, a vehicular fuel, and an aircraft fuel. The role of coal in future hydrogen production was seen as providing the major competitive technology to nonfossil hydrogen production. Conditions (constraints placed on the use of natural fossil fuels an synthetic fossil fuels) under which hydrogen might be produced primarily from nonfossil energy sources are analyzed. A possible scenario was suggested for the transition to a nonfossil energy era, and areas where hydrogen could be expected contribute to domestic energy needs were indicated. GRA

N82-15542# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Technische Physik.

HYDROGEN AS CARRIER OF SECONDARY ENERGY: PROPOSAL FOR A RESEARCH AND DEVELOPMENT PROGRAM

H. Buhl, C. Carpetis, J. Nitsch, W. Peschka, Y. Schott, W. Seeger, W. Schnurnberger, H. Steeb, and H. J. Sternfeld Jun. 1981 94 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-732)

(DFVLR-Mitt-81-10) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 14.20

The nuclear or solar production of hydrogen may become economically attractive in the future. The technological problems of the production and the introduction of hydrogen into the energy system are shown. Suitable research development efforts are recommended to achieve a complete ensured scope of knowledge concerning hydrogen systems. A.R.H.

04
FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

A82-10372 **Reduced heat flow - Mean heat flow relationship for the continental geothermal provinces.** S. Maj (Polska Akademia Nauk, Instytut Geofizyki, Warsaw, Poland). *Acta Geophysica Polonica*, vol. 28, no. 3, 1980, p. 233-240. 10 refs.

A82-10965 # **Fuel for future transport aircraft.** G. D. Brewer (Lockheed-California Co., Burbank, CA). *American Society of Mechanical Engineers and American Institute of Chemical Engineers, National Heat Transfer Conference, 20th, Milwaukee, WI, Aug. 2-5, 1981, ASME Paper 81-HT-80.* 8 p. 6 refs. Members, $2.00; nonmembers, $4.00.

Despite attempts at conservation and the development of synthetic aviation-grade kerosene from alternative fossil fuel materials, it is widely recognized that alternatives to conventional petroleum-base aircraft fuels must become available in the near future. The present paper discusses the prospects for liquid hydrogen as a future fuel for transport aircraft. Advantages of liquid hydrogen over synthetic fuels and liquid methane as alternative fuels in the areas of availability, safety, pollution, relative energy efficiency as a function of trip length and aircraft weight, overall costs and airport compatibility are considered. The possible requirements for a development program aimed at preparing liquid hydrogen for use in operational aircraft are examined, and the probable time characteristics of fuel use during the transition to liquid hydrogen, which may significantly replace synthetic fuels by the year 2000, are considered. A comprehensive plan for liquid hydrogen fuels R&D is then presented which is currently being considered for implementation on an international basis. A.L.W.

A82-11033 **One-dimensional model of vapor-dominated geothermal systems.** J. M. Straus (Aerospace Corp., Space Sciences Laboratory, Los Angeles, CA) and G. Schubert (Aerospace Corp., Space Sciences Laboratory; California, University, Los Angeles, CA). *Journal of Geophysical Research*, vol. 86, Oct. 10, 1981, p. 9433-9438. 15 refs. NSF Grant No. ENG-76-82119.

A one-dimensional model of vapor-dominated geothermal systems in the natural state is developed in order to study the ranges of the heat and mass transport and flow resistance at which a system is capable of existing in the vapor-dominated state. The model consists of a near-surface condensate layer lying above a two-phase counterflow region with rising steam and descending water in a porous saturated medium. Examination of models with condensate layers several hundred meters thick and reservoir temperatures near 513 K, characteristic of real systems, reveals them to have net mass flow rate/thermal conductivity ratios less than about 2.5 x 10 to the -7th K sec-squared/cu m and permeability/thermal conductivity ratios greater than 4.5 x 10 to the -17th m sec-cubed K/kg. Application of the model to the temperature and pressure data for the main reservoir of the Kawah Kamojang geothermal system in West Java indicates a permeability/thermal conductivity ratio between 10 to the -15th and 10 to the -14th m sec-cubed K/kg, or a permeability between 4 and 40 mdarcy for a thermal conductivity of 4 J/m per sec per K. Results also require the existence of a lower permeability cap overlying the higher permeability main reservoir in order to stabilize the water layer above the steam region. A.L.W.

A82-11834 # **Present status of Florida Power Corporation's D.O.E. funded feasibility study of the Higgins plant repowering/coal gasification project.** M. H. Kleinman (Florida Power Corp., St. Petersburg, FL) and E. Lechpammer (Stone and Webster Engineering Corp., Boston, MA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2086-2090. Research supported by the U.S. Department of Energy.

A82-11835 # **Status report on Central Maine Power Company's DOE Funded feasibility study of the Sears Island integrated gasification combined cycle power plant.** R. E. Cummings and P. C. Hastings (Central Maine Power Co., Augusta, ME). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2091-2095. Research supported by the U.S. Department of Energy.

A82-11836 # **Coal fired air turbine cogeneration.** R. W. Foster-Pegg (Westinghouse Electric Corp., Pittsburgh, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3.
New York, American Society of Mechanical Engineers, 1981, p. 2103-2108. 7 refs.

Fuel options and generator configurations for installation of cogenerator equipment are reviewed, noting that the use of oil or gas may be precluded by cost or legislation within the lifetime of any cogeneration equipment yet to be installed. A coal fueled air turbine cogenerator plant is described, which uses external combustion in a limestone bed at atmospheric pressure and in which air tubes are sunk to gain heat for a gas turbine. The limestone in the 26 MW unit absorbs sulfur from the coal, and can be replaced by other sorbents depending on types of coal available and stringency of local environmental regulations. Low temperature combustion reduces NOx formation and release of alkali salts and corrosion. The air heat is exhausted through a heat recovery boiler to produce process steam, then can be refed into the combustion chamber to satisfy preheat requirements. All parts of the cogenerator are designed to withstand full combustion temperature (1500 F) in the event of air flow stoppage. Costs are compared with those of a coal fired boiler and purchased power, and it is shown that the increased capital requirements for cogenerator apparatus will yield a 2.8 year payback. Detailed flow charts, diagrams and costs schedules are included.
M.S.K.

A82-11837 # **Enthanol fuels from biomass projects.** B. C. B. Hsieh. In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2109-2111.

About 100 projects are proposed or underway to convert organic crops such as corn and grains or waste organic material into a clean usable ethyl alcohol fuel. Total production capacity could reach more than two billion gallons per year in 1985, excluding beverage and industrial uses. Congressional appropriation of approximately one-half billion dollars to DOE/USDA for loan guarantees and federal and state laws exempting excise taxes can make this ethanol fuel from biomass possible. An overview and status of the projects will be reviewed. Net energy production of ethyl alcohol from biomass and the impacts of increasing alcohol fuel use will also be discussed. (Author)

A82-11848 # **An overview of peat gasification.** D. V. Punwani (Institute of Gas Technology, Chicago, IL). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2172-2177. 21 refs.

Thermal and biological peat gasification processes are reviewed, with research showing that peat is high in both oxygen and hydrogen, and also nitrogen, which can be used to form ammonia as a byproduct. The hydrogen-carbon ratio of peat has been shown to exceed that of subbituminous coal, indicating less of a need to supply more hydrogen in the formation of gaseous fuels. The gasification process involves crushing the peat into particles smaller than 2 mm, which cascade through drying air into a gasifier, where gases from the hydrogasifier induce hydropyrolysis. The char then flows into a reactor with steam and oxygen to make synthesis gas. Minnesota peat has shown the highest hydrocarbon yields in the U.S., and economic comparisons show peak gasification has economic parity with other means of producing SNG. Experiments have

also shown the feasibility of wet peat conversion using a peat-water slurry in an anaerobic digestor to produce methane. Building of pilot plants is suggested as necessary to verify existing processes. M.S.K.

A82-11849 # Production of synthetic crude oil from coal using the TOSCOAL pyrolysis process. D. H. Cortez and C. J. LoDelfa (Tosco Corp., Los Angeles, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2178-2183.

A82-11850 # An overview of fluidized-bed combustion /FBC/ design practice. J.-Y. Shang, J. E. Notestein, and J. S. Mei (U.S. Department of Energy, Morgantown Energy Technology Center, Morgantown, WV). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2184-2191.

A short history of fluidized bed coal combustion is provided, noting that addition of a limestone bed contributes to sulfur retention, and comparisons are made with stoker and pulverized bed boilers. Advantages to fluidized bed combustion (FBC) are given as the thermal inertia of the limestone bed, inherent vigorous mixing for turbulent, efficient combustion, and larger particle size than in a catalytic cracker. Major components of an FBC are described, including windbox, distributor, feeder system, combustion chamber, bed material drainage, and primary dust recovery system. Fundamental differences between FBC and conventional boiler technology are stressed and design considerations for an FBC are listed with explanations. Recirculation of fly ash is shown to be effective only with an in-combustor vortex, which returns the ash to the flame before it has time to cool. Finally, ongoing experiments to determine the relative usefulness of burning various alternate fuels such as shales, lignite, and shredded tires in an FBC are reported. M.S.K.

A82-11851 # Application of HTGR process heat to oil shale retorting. D. C. Wadekamper, I. N. Taylor, T. E. Gleason (General Electric Co., Pleasanton, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2192-2197.

The currently developed oil shale retorting processes depend on some portion of their product to provide heat energy for process operation. In an attempt to increase the fossil fuel reserves of the United States, as well as decrease environmental pollution, it has been suggested that an High Temperature Gas Reactor (HTGR) be used to supply the heat necessary for the retorting oil shale thus freeing additional petroleum products for sale. The TOSCO II process was selected as a typical oil shale retorting process and a detailed evaluation of the energy requirements was made. Various scenarios to replace selected portions of the process energy requirements with HTGR generated heat are described. The improvements in product yields and reductions in environmental pollution levels associated with a HTGR process heat scheme are summarized.

(Author)

A82-12021 † Jet fuel from carbon (Reaktivnoe toplivo iz uglia). A. A. Krichko, M. K. Iulin, A. C. Arifulin, T. C. Nikiforova, and V. A. Puchkov (Akademiia Nauk SSSR, Institut Goriuchikh Iskopaemykh, Moscow, USSR). *Khimiia i Tekhnologiia Topliv i Masel*, no. 9, 1981, p. 3-5. 8 refs. In Russian.

A jet fuel of the T-8V type has been obtained by isomerization and hydrogenation at 4 MPa of the hydrorefined 180-320 C fraction of a liquid-phase carbon hydrogenation product. The flow scheme and the material balance of the process are presented. V.L.

A82-12022 † A protective additive for jet fuels (Zashchitnaia prisadka k reaktivnym toplivam). O. P. Lykov, G. I. Shor, V. P. Lapin, V. V. Sashevskii, and L. I. Mosina (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR). *Khimiia i Tekhnologiia Topliv i Masel*, no. 10, 1981, p. 37-40. 6 refs. In Russian.

A study has been carried out to investigate the protective action of an additive to jet fuels which consists of a mixture of dimers and trimers of synthetic fat acids. Results indicate that there exists a correlation between changes in the protective properties of the fuel as a function of the additive content, on the one hand, and changes in certain electrophysical characteristics of the fuel (e.g., conductivity, contact potential difference change, and electrifiability), on the other hand. V.L.

A82-12275 Geothermal systems: Principles and case histories. Edited by L. Rybach (Zürich, Eidgenössische Technische Hochschule, Zurich, Switzerland) and L. J. P. Muffler (U.S. Geological Survey, Menlo Park, CA). Chichester, Sussex, England and New York, Wiley-Interscience, 1981. 371 p. $61.95.

The classification of geothermal systems is considered along with the geophysical and geochemical signatures of geothermal systems, aspects of conductive heat transfer and regional heat flow, and geothermal anomalies and their plate tectonic framework. An investigation of convective heat and mass transfer in hydrothermal systems is conducted, taking into account the mathematical modelling of hydrothermal systems, aspects of idealized convective heat and mass transport, plausible models of geothermal reservoirs, and preproduction models of hydrothermal systems. Attention is given to the prospecting for geothermal resources, the application of water geochemistry to geothermal exploration and reservoir engineering, heat extraction from geothermal reservoirs, questions of geothermal resource assessment, and environmental aspects of geothermal energy development. A description is presented of a number of case histories, taking into account the low enthalpy geothermal resource of the Pannonian Basin in Hungary, the Krafla geothermal field in Northeast Iceland, the geothermal system of the Jemez Mountains in New Mexico, and extraction-reinjection at the Ahuachapan geothermal field in El Salvador. G.R.

A82-12400 Energy from biomass and wastes V; Proceedings of the Fifth Symposium, Lake Buena Vista, FL, January 26-30, 1981. Symposium sponsored by the Institute of Gas Technology. Chicago, Institute of Gas Technology, 1981. 1100 p. $75.

Papers are presented in the areas of biomass production and procurement, biomass and waste combustion, gasification processes, liquefaction processes, environmental effects and government programs. Specific topics include a water hyacinth wastewater treatment system with biomass production, the procurement of wood as an industrial fuel, the cofiring of densified refuse-derived fuel and coal, the net energy production in anaerobic digestion, photosynthetic hydrogen production, the steam gasification of manure in a fluidized bed, and biomass hydroconversion to synthetic fuels. Attention is also given to the economics of deriving alcohol for power applications from grain, ethanol fermentation in a yeast-immobilized column fermenter, a solar-fired biomass flash pyrolysis reactor, particulate emissions from controlled-air modular incinerators, and the DOE program for energy recovery from urban wastes. A.L.W.

A82-12531 U.S. Department of Energy liquid synfuels overview. E. J. Lievens, Jr. (U.S. Department of Energy, Washington, DC). In: The year of the Shuttle; Proceedings of the Eighteenth Space Congress, Cocoa Beach, FL, April 29-May 1, 1981. Cocoa Beach, FL, Canaveral Council of Technical Societies, 1981, p. 3-1 to 3-17.

The U.S. Department of Energy (DOE) has been participating in four programs to convert coal to liquid synfuels through direct liquefaction; the Solvent Refined Coal programs (SRC-I and SRC-II), the Exxon Donor Solvent Pilot Plant, and the Ebullated-Bed Pilot Plant (H-coal). The processes, products, and technical status of each of the DOE liquefaction programs are described. The Administration's proposal to discontinue DOE activities in these programs, while assisting industrial participants, is discussed. Finally, the results of DOE studies of industrial needs to implement a major coal derived liquid synfuel program are summarized. Results predict that resources are adequate to develop a capacity of liquid fuels equal to a million barrels/day by the year 2000; the impediments to increasing this capacity to three million barrels/day in that time span are identified. J.F.

A82-12533 Biomass resources for alcohol fuels. J. E. MacDowell (Planning Research Corp., Cocoa Beach, FL). In: The year of the Shuttle; Proceedings of the Eighteenth Space Congress, Cocoa Beach, FL, April 29-May 1, 1981. Cocoa Beach, FL, Canaveral Council of Technical Societies, 1981, p. 3-42 to 3-63. 20 refs.

The production of alcohol fuel from biomass represents a fast and practical means of adding to the dwindling petroleum supply. The biomass feed-stocks which will feed the alcohol distilleries must be carefully selected. Using food chain biomass crops for conversion to alcohol will cause a reduction in the amount of food available and increase the cost of food and alcohol feedstocks. The food chains should not be drastically interrupted, and agricultural economic balances should not be altered. Various alternatives to alcohol production are presented, which lie within the confines of selected biomass feedstocks and will not interrupt normal agricultural activities. A corn processing and distillation process is shown graphically as an example; the biomass to alcohol conversion potential of feedstocks is given, and the potential cropland for conversion in the U.S.A. is shown as a percentage of the nation's total land area. J.F.

A82-12888 Study of the electric conductivity of plasma from fuel combustion products containing a weakly ionizing impurity. E. K. Chekalin, V. A. Tishchenko, and I. B. Rozhdestvenskii (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 19, Mar.-Apr. 1981, p. 225-229.) *High Temperature,* vol. 19, no. 2, Sept. 1981, p. 159-163. 12 refs. Translation.

The Q factor of a high-frequency circuit is measured to determine experimentally the electric conductivity of a combustion-product plasma using high-ash coals with potassium impurities at the outlet of a high-temperature cyclonic combustion chamber. The electric conductivity of the plasma formed from the combustion products of the coal is calculated under conditions comparable to the experimental conditions. Calculations are carried out both for a completely equilibrium composition, taking into account condensed compounds of potassium with aluminum and silicon oxides, and for a 'frozen' composition in which potassium compounds of this type are neglected. C.R.

A82-14008 # Implementation of a siting methodology for utility size WECS in western Massachusetts and northwestern Connecticut. R. H. Kirchhoff and F. C. Kaminsky (Massachusetts, University, Amherst, MA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2540.* 10 p. 11 refs.

This paper describes a long term research project by Northeast Utilities and the University of Massachusetts to identify candidate sites for utility size wind energy systems in Western Massachusetts and Northwestern Connecticut. A generalized methodology is described for identifying the candidate sites. This methodology includes the use of biological wind prospecting, data collection with TALA kites, computerized wind mapping with MATHEW, and the installation of long run data collection stations. This paper also describes the use of a mass consistent flow model known as MATHEW in developing computerized wind maps for selected regions of the area under study. (Author)

A82-14395 # Aviation gasoline versus automotive gasoline. K. J. Biehl (FAA, Technical Center, Atlantic City, NJ). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1705.* 4 p. 5 refs.

FAA research on aviation gasoline versus automotive gasoline is reviewed, noting regulations governing engine/aircraft fuel systems. The research has shown that from the antiknock/octane rating standpoint, only aviation grade 80/87 fuel may be replaced by autogas. Fuel-system vapor lock is identified as a major problem requiring definition by aircraft fuel system design relative to operational limitations. Future testing will evaluate both high-wing and low-wing systems to investigate material incompatibility and corrosion; antiknock; preignition and deposit ignition; engine durability and spark-plug operation. S.C.S.

A82-14986 Fuels from biomass and wastes. Edited by D. L. Klass (Institute of Gas Technology, Chicago, IL) and G. H. Emert (Arkansas, University, Fayetteville, AR). Ann Arbor, MI, Ann Arbor Science Publishers, Inc., 1981. 602 p. $39.95.

The production, use, and effects of fuels from biomass and waste energy sources are discussed. Biomass procurement from silviculture, including hybrid poplar and sycamore farms, in addition to the growth of mass algal culture and Jerusalem artichokes for fuels are considered. The conversion of biomass and solid waste materials through biological and thermal gasification, hydrolysis and extraction, and fermentation to produce ethanol, along with natural and thermal liquefaction processes involving euphorbia lathyris and cellulosic materials are elaborated. Environmental and health aspects of biomass and waste conversion systems are outlined, noting the large land surface areas needed for significant contributions to total demands from biomass, specific instances and case studies are reviewed for biomass use in Indiana, the Dominican Republic, the southeast U.S., and in small wood stoves. M.S.K.

A82-15722 † Optimization of the composition and antidetonation properties of AI-93 gasoline (Optimizatsiia komponentnogo sostava i antidetonatsionnykh svoistv benzina AI-93). B. A. Englin, Iu. N. Nilov, V. E. Emel'ianov, and G. E. Levinson (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Neftianoi Promyshlennosti, Moscow, USSR). *Khimiia i Tekhnologiia Topliv i Masel,* no. 11, 1981, p. 19-23. 7 refs. In Russian.

The antidetonation properties of AI-93 gasoline are examined and compared with detonation specifications on automobiles manufactured by the VAZ plant. It is shown that the octane number of AI-93 may be reduced by optimizing its composition. Results of an evaluation of 90-91-octane gasolines containing methyl-tert-butyl ether are presented. V.L.

A82-17007 Comparison of Michigan Basin crude oils. E. A. Vogler (Indiana, University, Bloomington, IN), P. A. Meyers (Michigan, University, Ann Arbor, MI), and W. A. Moore (Central Michigan University, Mt. Pleasant, MI). *Geochimica et Cosmochimica Acta,* vol. 45, Nov. 1981, p. 2287-2293. 24 refs. Grant No. NGR-15-003-118.

Michigan Basin oils from the Ordovician Trenton, Silurian Niagaran, and Devonian Dundee formations have been geochemically compared by GC, GC-MS, and carbon isotope mass spectrometry. One oil from each formation was selected for detailed analysis which included measurement of individual n-alkane delta 13 C values. The Ordovician and Devonian oils are strikingly similar to one another, yet clearly different from the Silurian oil. This pattern is unexpected because Ordovician and Devonian reservoirs are physically separated by the Silurian strata. From time-temperature considerations, the Devonian oil probably was formed in older strata and has migrated to its present location. Our analyses suggest a common source for the Devonian and Ordovician oils. (Author)

A82-17632 # Characteristics of vertical wind profiles. B. H. Bailey (New York, State University, Albany, NY). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 49-54. 10 refs. Research supported by the New York State Energy Research and Development Authority.

Results of vertical wind profile studies of four sites with similar surface roughness lengths in New York state are reported. Anemometry at several levels supplied 20 sec, one minute, and 15 minute interval readings covering 1-2 yr. Average power law coefficients for all sites were determined for different stability classes, i.e. lapse rate intervals expressing temperature changes with heights. Diurnal characteristics were determined as stable conditions dominating during the night while neutral and unstable conditions dominate during the day, when higher winds were measured. The power law coefficients were therefore large at night and low in daytime. Similarities in the power law coefficients are taken as evidence that vertical wind profile characteristics are not necessarily site specific, and the 1/6 or 1/7 power law is adequate in wind regimes of 7 m/sec or greater. M.S.K.

A82-17645 # Wind energy and the Nation's rural electric systems. W. Prichett, III (National Rural Electric Cooperative Association, Washington, DC). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 144-149.

A82-17974 The corrosion of some superalloys in contact with coal chars in coal gasifier atmospheres. D. L. Douglass

(California, University, Los Angeles, CA), V. S. Bhide (IBM Corp., San Jose, CA), and E. Vineberg (Climax Molybdenum Co., Ann Arbor, MI). *Oxidation of Metals*, vol. 16, Aug. 1981, p. 29-79. 7 refs.

A82-18114 **Biomass conversion processes for energy and fuels.** Edited by S. S. Sofer (Oklahoma University, Norman, OK) and O. R. Zaborsky (NSF, Washington, DC). New York, Plenum Press, 1981. 434 p. $49.50.

The book treats biomass sources, promising processes for the conversion of biomass into energy and fuels, and the technical and economic considerations in biomass conversion. Sources of biomass examined include crop residues and municipal, animal and industrial wastes, agricultural and forestry residues, aquatic biomass, marine biomass and silvicultural energy farms. Processes for biomass energy and fuel conversion by direct combustion (the Andco-Torrax system), thermochemical conversion (flash pyrolysis, carboxylolysis, pyrolysis, Purox process, gasification and syngas recycling) and biochemical conversion (anaerobic digestion, methanogenesis and ethanol fermentation) are discussed, and mass and energy balances are presented for each system. A.L.W.

A82-18122 **Alternate fuels; Proceedings of the International Congress and Exposition, Detroit, MI, February 23-27, 1981.** Congress and Exposition sponsored by the Society of Automotive Engineers. Warrendale, PA, Society of Automotive Engineers, Inc. (SAE Proceedings SP-480), 1981. 255 p. $24.95.

Alternative fuels for use in diesel engines are reviewed, and specific mention is made of multicylinder diesel engine tests with unstabilized water-in-fuel emulsions, fuel nitrogen conversion, performance, and emission characteristics of blended SRC-II in a high-speed diesel engine, and a diesel engine running on raw coal-diesel fuel slurries. Attention was also given to ethanol fuel in regards to efficiency and exhaust emissions, heavy duty truck operation on unstabilized methanol/diesel fuel emulsions, and the road performance of a diesel vehicle with a supplementary carburation of alcohol. The use of hydrogen fuels in automobiles is considered, along with onboard hydrogen generation for hydrogen injection into internal combustion engines, hydrogen fueled-vehicle testing to provide a data base, and liquid hydrogen onboard storage and servicing. M.S.K.

N82-10115 Louisiana State Univ. and A&M Coll., Baton Rouge.
METHANE PRODUCTION FROM ALKALINE FOOD WASTE Ph.D. Thesis
Wilson Thomas Gautreaux, Jr. 1981 222 p
Avail: Univ. Microfilms Order No. 8117624

Because of waste generated by potato processing contained significant quantities of carbohydrate degradation products and sodium carbonate anaerobic digestion was determined to be a reliable process for waste treatment and methane production. The high sodium levels did not inhibit anaerobic digestion at a substate concentration of 1.0 wt percent alkaline peel solids. In two-stage bench-scale studies at 37 C, methane production averaged 0.28 m cu/kg COD feed or 0.65 m cu/(m cu d) in a settled bacterial sludge methane fermenter with a 4 day retention time. A pilot-scale anaerobic digestion system with a 15.4 m cu fermenter demonstrated the feasibility of a proposed anaerobic pond system for a food processing plant. With a 1.0 wt percent alkaline solids feed and a 9-day retention time, methane production averaged 0.16 m cu/kg solids or 0.18 m cu/m cu d). A process for single cell protein production via the acid stage of anaerobic digestion was explored. Bacterial cell and protein yields of 0.18 and 0.09 kg/k glucose consumed were obtained at a retention time of four hours. Dissert. Abstr.

N82-10141# Illinois Inst. of Tech., Chicago. Dept. of Engineering.
SEPARATION OF PARTICLES FROM COAL DERIVED LIQUIDS VIA SURFACE CHARGE PROPERTIES Final Report, Aug. 1977 - May 1981
Dimitri Gidaspow and Darsh Wasan Jul. 1981 97 p refs
(Contract DE-AS02-77ET-10445)
(DE81-029088; DOE/ET-10445/1) Avail: NTIS HC A05/MF A01

An improved method of removal of fine particles suspended in nonaqueous media by the application of a high-voltage (1000 to 10,000 V/cm) electric field was developed. The technique is a modification of ordinary cross-flow filtration with a porous tube and of forced flow electrophoresis. The electrofilter was tested with a synthetic nonaqueous slurry as well as samples of diluted H-coal process liquids obtained from a coal liquefaction pilot plant at various electric field strengths, driving pressures, and feed rates. Models of clear boundary layers for flat and tubular cross-flow electrofilters were developed as a function of inlet Peclet number, electrophoretic velocity of particles, and rate of filtration. DOE

N82-10143# State Univ. of New York, Binghamton. Dept. of Chemistry.
DESULFURIZATION WITH TRANSITION METAL CATALYSTS Quarterly Technical Progress Report, 28 Mar. - Jun. 1981
John J. Eisch 31 Jul. 1981 4 p
(Contract DE-AC22-79ET-14879)
(DE81-028935; DOE/ET-14879/T6) Avail: NTIS HC A02/MF A01

The reactivity and the intermediates in the desulfurization of 2-methyl dibenzo thiophene and certain model sulfides and sulfones were examined. The ratio of bis-1,5-cyclo octadiene nickel, the desulfurizing activity of soluble organo cobalt complexes, and the activity of aluminum hydride combinations with nickel (11), cobalt(11), and molybdenum(0) or molybdenum (IV) salts were also studied. Experimental procedures for applying these techniques to coal derived liquids were also addressed. DOE

N82-10144# Worcester Polytechnic Inst., Mass.
KINETICS AND MECHANISMS OF CATALYTIC HYDROLIQUEFACTION AND HYDROGASIFICATION OF LIGNITE Quarterly Report, Apr. - Jun. 1981
Wilmer L. Kranich, Kamel Guruz, and Alvin H. Weiss 10 Aug. 1981 24 p refs
(Contracts DE-FG22-81PC-40770; DE-AC22-77ET-10618)
(DE81-023581; DOE/PC-40770/T2; QR-2) Avail: NTIS HC A02/MF A01

The variables involved in the hydroliquefaction and hydrogasification of lignite were studied. Emphasis was placed on the catalytic batch hydroliquefaction of a range of low rank coals including two subbituminous coals, four lignites, and leonardite, as well as cellulose. These were studied both as received and after partial demineralization by washing with hydrochloric acid. DOE

N82-10148# Yale Univ., New Haven, Conn. School of Medicine.
DEVELOPMENT OF NEWER METHODS FOR THE ISOLATION AND IDENTIFICATION OF CERTAIN COMPONENTS FOUND IN COMPLEX MIXTURES DERIVED FROM ENERGY SOURCES AND THE DETERMINATION OF THEIR BIOLOGICAL ACTIVITY VIA BIOASSAY SYSTEMS Progress Report, Aug. 1980 - Jul. 1981
S. R. Lipsky Jul. 1981 29 p refs Prepared in cooperation with LASL, N. Mex.
(Contract DE-AS02-76EV-02958)
(DE81-028311; DOE/EV-02958/T1) Avail: NTIS HC A03/MF A01

A composite sample of Paraho crude oil was fractionated and the fractions chemically identified by multidimensional gas chromatography. The fractions were then bioassayed to determine their biological activity. DOE

N82-10150# Energy and Environmental Research Corp., Santa Ana, Calif.
SOOT FORMATION IN SYNTHETIC FUEL DROPLETS Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981
G. England, J. Kramlich, Y. Kwan, and R. Payne Jul. 1981 36 p
(Contract DE-AC22-80PC-30298)
(DE81-028391; DOE/PC-30298/T3; QRPR-3) Avail: NTIS HC A03/MF A01

Fuel screening studies in the 70000 Btu/h tunnel furnace were extended to include SRC-11 middle and heavy distillate fuel oils. A total of eight fuels were investigated. Soot, particulates, and NOx emission levels were obtained under comparable firing conditions for both normal and staged combustion, and at various overall excess air levels. The combustion of single-droplet streams was investigated in a controlled flow reactor. The trajectory of every SRC-11 fuel droplet was observed to determinate in a microexplosion. High speed photography showed this to be an extremely rapid event resulting in the formation of a visible,

luminous soot cloud. This behavior was not observed for a petroleum-derived No. 6 oil and appeared to be pronounced for a blended SRC-11 than for either the middle or heavy distillate fuels. Preliminary measurement were also made of local soot concentrations and of the temprature of the soot sheet in the reactor system. J.M.S.

N82-10152# Air Products and Chemicals, Inc., Allentown, Pa.
CRYOGENIC METHANE SEPARATION/CATALYTIC HYDROGASIFICATION PROCESS ANALYSIS Quarterly Report
J. Klosek Aug. 1981 42 p
(Contract DE-AC01-78ET-10325)
(DE81-029123; DOE/ET-10325/T11) Avail: NTIS HC A03/MF A01

Two commercial gasification processor were evaluated in terms of their relative effectiveness in separating methanes from the reaction products and some of the other synthesis gas products recycled. Cryogenic methane separation results from the process gas recovered by partial condensation and carbon absorption are reported. Preliminary plant designs for acid gas removal and cryogenic methane separation from the raw gas are also reported. R.C.T.

N82-10153# Brookhaven National Lab., Upton, N. Y.
FLAME-RETENTION HEAD BURNER EFFICIENCY TEST RESULTS AND ANALYSIS: SPACE-HEATING-EQUIPMENT TEST PROGRAM
R. J. McDonald and R. F. Krajewski Nov. 1980 26 p refs
(Contract DE-AC01-76CH-00016)
(DE81-030219; BNL-51321) Avail: NTIS HC A03/MF A01

Fuel oil savings resulting from the use of flame-retention head burners in residential oil-fired hydronic heating units are summarized. Results of laboratory and field tests are compared. The fuel savings varied between 5.1% and 22.0% for various systems. DOE

N82-10154# New Hampshire Univ., Durham.
LIQUEFACTION OF BITUMINOUS COALS USING DISPOSAL ORE CATALYSTS AND HYDROGEN Quarterly Progress Report, 7 May - 7 Aug. 1981
V. K. Mathur Aug. 1981 17 p
(Contract DE-AC22-81PC-41035)
(DE81-029134; DOE/PC-41035/1) Avail: NTIS HC A02/MF A01

Hydrogenation of coal-oil slurry by hydrogen using disposal ore catalysts (DOC) with special reference to maximizing liquefaction and minimizing viscosity of product oil was studied. A number of companies were contacted to collect samples of ores and ore concentrates containing cobalt, molybdenum, nickel and other metals considered to posses catalytic activity and a commercial Co-Mo catalyst (0402T) are reported. These data are to be used as a base for evaluating the catalytic effects of the ores and minerals collected. DOE

N82-10155# Physical Sciences, Inc., Woburn, Mass.
SYNTHETIC-FUEL COMBUSTION; POLLUTANT FORMATION. SOOT-INITIATION MECHANISMS IN BURNING AROMATICS Quarterly Report, 1 Apr. - 30 Jun. 1981
T. Tanzawa, S. P. Schertzer, and W. T. Rawlins 1981 21 p refs
(Contract DE-AC22-80PC-30292)
(DE81-029480; DOE/PC-30292/3; PSI-TR-284; QR-3) Avail: NTIS HC A02/MF A01

Toluene pyrolysis experiments were performed using He-Ne laser beam attenuation to monitor soot. The experimental results were consistent with those of previous investigators; however, the laser beam attenuation records showed an anomalously large absorption at the higher temperatures where soot formation should be minimal. This effect could be due to some light-absorbing gas-phase species such as PCAH and/or radicals of PCAH. Diagnostics employed show ambiguous late-time behavior of the pressure, density, and beam attenuation profiles. DOE

N82-10156# Argonne National Lab., Ill.
CYCLONE PERFORMANCE ESTIMATEE FOR PRESSURIZED FLUIDIZED-BED COMBUSTION
R. F. Henry and W. F. Podolski Jul. 1981 33 p refs
(Contract W-31-109-eng-38)
(DE81-028504; ANL/CEN/FE-81-4) Avail: NTIS HC A03/MF A01

Hot pressurized flue gas from pressurized fluidized-bed combustion must be cleaned up prior to its expansion in a gas turbine as part of the combined-cycle electric power generation concept. The performance of conventional cyclones in experimental tests has been compared with theory, with reasonable agreement. Prediction of the performance of a larger cyclone system shows that three stages should provide the cleanup required on the basis of current estimates of turbine tolerance of particulate matter. Advances in hot gas cleanup - optimized cyclones, augmented cyclones, and alternative devices should provide future improvement in cycle efficiencies and costs, but simple cyclones are planned for first-generation PFB/CC pilot and demonstration plants. DOE

N82-10157# Spectron Development Labs., Inc., Costa Mesa, Calif.
PARTICULATE PROCESSES IN PULVERIZED-COAL FLAMES Quarterly Technical Progress Report, Jan. - Mar. 1981
Apr. 1981 65 p refs
(Contract DE-AC22-80PC-30300)
(DE81-025153; DOE/PC-30300/T3) Avail: NTIS HC A04/MF A01

The design of the entire apparatus for the dilute particle reaction experiment was completed. This includes two reactor heads, a fluidized bed feeder, the tube reactor, and the reactor traverse mechanism. Experimental observations of ignition and devolatilization of Pittsburgh Seam HVA bituminous coal were initiated. Observations using both front and back light pulsed laser holography and particle sizing interferometry were made. Preliminary analysis of the data indicate that high quality results can be obtained. DOE

N82-10158# Physical Sciences, Inc., Woburn, Mass.
PULVERIZED-FUEL COMBUSTION: MODELING AND SCALEUP METHODOLOGIES Quarterly Report, 1 Apr. - 30 Jun. 1981
Paul F. Lewis, Evan R. Pugh, Nelson N. Kemp, Alan Gelb, and Thomas Wolf Aug. 1981 30 p refs
(Contract DE-AC22-80PC-30294; QR-3)
(DE81-026546; DOE/PC-30294/3; PSI-TR-280) Avail: NTIS HC A03/MF A01

Effort this quarter has continued on model improvements, and the data analysis task has begun. Specific work reported includes: model of the heterogeneous reactions of coal chars, work on particle-particle collisions, improvements in the computer code to handle the stiff nature of the particle momentum and energy equations, and identification of a set of experiments with which to start the data analysis. Results of these efforts are: a model for heterogeneous carbon reactions including OH and O reactions, a model for collisional drag effects, improved numerical stability of the code, and beginning of data analysis. DOE

N82-10201# Idaho National Engineering Lab., Idaho Falls
CORROSION TESTING OF CARBON STEEL IN AEREATED GEOTHERMAL BRINE
D. F. Suciu and P. M. Wikoff Idaho Falls, Idaho Edgerton, Germeshausen and Grier, Inc. Feb. 1981 55 p refs
(Contract DE-AC07-76ID-01570)
(DE81-028653; EGG-GTH-5474) Avail: NTIS HC A04/MF A01

Two major problems are associated with the use of cooled geothermal water as coolant for the 5 MW(e) Pilot Power Plant and Raft River are: a scaling potential owing to the chemical species present in solution, and the corrosive nature of the geothermal water on carbon steels. A water treatment test program was established to reduce or eliminate these problems. Data show that scale can be prevented by a combination of dispersants and controlling the concentration of scaling species in the circulating water. Corrosion cannot be controlled without a pretreatment of tubing material. With the pretreatment, a protective gamma iron oxide film is laid down on the tube surface, that with proper corrosion inhibitor additives, significantly reduces both general and pitting corrosion. However, longer term testing is required to determine protection of pitting corrosion. DOE

N82-10249# North Dakota Univ., Grand Forks.
CHEMISTRY OF LIGNITE LIQUEFACTION Quarterly Report, Apr. - Jun. 1981
R. J. Baltisberger, Virgil I. Stenberg, Kenneth J. Klabunde, and Neil F. Woolsey Jul. 1981 55 p refs

(Contract DE-AB18-78FC-02101)
(DE81-030178; DOE/FC-02101/18) Avail: NTIS HC A04/MF A01

Progress reports are presented for structural studies of lignite derived asphaltene and preasphaltenes and other cleavage studies. Reports of denitrogenation caused by CO and water reactions and of electron transfer catalysis studies are also presented. Results indicate that the major differences between asphaltenes and preasphaltenes is that the molecular weight maximizes near 1500 g/mol for the preasphaltenes compared to 400 g/mol for the asphaltenes. It is further indicated that asphaltenes have little or no aliphatic or aryl aliphatic ethers whereas preasphaltenes have significant amounts. Other significant results are reported. DOE

N82-10250# Department of Energy, Bartlesville, Okla. Energy Technology Center.
LIQUID FOSSIL FUEL TECHNOLOGY Quarterly Technical Progress Report, Oct. - Dec. 1980
May 1981 77 p refs
(DE81-029912; DOE/BETC/QPR-80/4) Avail: NTIS HC A05/MF A01

Highlights of research activities at BETC during the past quarter are summarized. Major research areas include: liquid fossil fuel cycle, extraction (resource assessment and enhaned producton); processing (characterization, thermodynamics, and process technology); utilization; and product integration and technology transfer. DOE

N82-10251# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.
MOLTEN-SALT COAL-GASIFICATION PROCESS DEVELOPMENT UNIT, PHASE 2 Quarterly Technical Progress Report, Jan. - Mar. 1981
M. H. Slater 20 Apr. 1981 57 p refs
(Contract DE-AC21-77ET-10296)
(DE81-023585; DOE/ET-10296/T2; ESG-DOE-13363; QTPR-3) Avail: NTIS HC A04/MF A01

Run 7, the second run of the Phase 2 program, was completed. The gasification system was operated for a total of 169 h at pressures up to 90 psig. Average product gas HHV values of 81 Btu/scf were recorded during 90-psig operation, while gasifying coal at a rate of 735 lb/h. The run was terminated, as planned, after 7 full days of operation. Prior to Run 7, an 80% cobalt-20% chromium alloy metal melt withdrawal orifice was installed as a replacement for a high-purity alumina orifice which had cracked during Run 6; and thus, it is suspected, contributed to the overflow system plug which prematurely terminated the test. The new metal orifice survived the entire Run 7 campaign virtually intact. DOE

N82-10253# Westinghouse Electric Corp., Concordville, Pa.
BASELINE DATA ON UTILIZATION OF LOW-GRADE FUELS IN GAS TURBINE APPLICATIONS. VOLUME 2: HOT COMPONENT CORROSION EVALUATION Final Report
J. J. Vitallo and S. T. Scheirer Jun. 1981 64 p Sponsored in part by Electric Power Research Inst.
(EPRI Proj. 1079-2)
(DE81-903760; EPRI-AP-1882-Vol-2) Avail: NTIS HC A04/MF A01

The corrosion of turbine parts when operated with residual oil versus distillate oil was compared. A metallographic evaluation of combustion turbine hot components, which showed partial residual versus total distillate fuel firing, revealed no discernable differences in component degradation (hot corrosion). Considering the time of operation, the degree of hot corrosion observed was somewhat greater than expected for oil-fired combustion turbines of similar designs and alloy selections. This abnormality was attributed to the ingestion of high levels of sodium contaminated mist from the adjacent cooling tower hrough the turbine compressor inlet. Corrosion due to vanadium compounds in the heavy fuel machines was practically nil, which indicates that residual fuel is satisfactory for use in combustion turbine plants. DOE

N82-10255# Gulf Research and Development Co., Pittsburgh, Pa.
UNDERGROUND GASIFICATION OF STEEPLY DIPPING BEDS. PHASE 2 REPORT: RESULTS OF RAWLINS TEST NO. 1 Final Report, 1 Mar. 1978 - 1 Mar. 1980
Jul. 1981 271 p refs Prepared in cooperation with TRW Energy Systems Planning Div., McLean, Va.
(Contract DE-AC03-77ET-13108)
(DE81-028581; DOE/ET-13108/T14) Avail: NTIS HC A12/MF A01

A 23 ft thick coal bed dipping at 63 deg was used to test the feasibility of using underground coal gasification techniques to extract energy from steeply dipping coal beds (UCG-SDB). The coal was ignited at a vertical depth of 400 ft utilizing a directionally drilled process well pair. The heating value of the product gas during the 21 day air injection phase initially climbed to approximately 180 Btu/SCF and gradually declined to the 120 to 130 Btu/SCF range. Air injection rates of 1600 to 2000 SCFM were used, and wet product gas rates between 3000 and 4500 SCFM were obtained. A 5 day steam/oxygen injection test was also conducted which increased the product gas heating value to the 220 to 260 Btu/SCF range. The environmental studies concentrated on ground water quality, air quality, surface subsidence, and personnel industrial hygiene. DOE

N82-10257# Bell Aerospace Co., Buffalo, N. Y.
HIGH-MASS-FLUX COAL GASIFIER Final Report
A. J. Simpkin May 1981 102 p refs
(Contract DE-AC01-79ET-14674)
(DE81-029807; DOE/ET-14674/16) Avail: NTIS HC A06/MF A01

This report describes the design, analysis, construction, and test activities associated with bringing a short residence time, entrained flow gasifier process development unit (PDU) to operational status are described. The basic high mass flux (HMF) gasifier, incorporated in the PDU, operates at a coal through-put of twelve tons per day, a pressure of fifteen atmospheres and processes coal, oxygen and steam to produce a synthesis. When applied to the production of substitute natural gas, the option exists to add secondary coal to the basic HMF gasifier, for the purpose of enhancing the methane content of the product. A secondary coal feed system was developed and its injection capability demonstrated in a cold flow test facility. Operability and performance of the synthesis gas stage of the HMF gasifier were demonstrated with Pittsburgh seam coal and North Dakota Lignite. Curtailment of testing precluded the conduct of any gasification tests with secondary coal injection. Included in the main program was a task to evaluate the effects of slag fluxing additives upon viscosity/temperature relationships for Pittsburgh seal coal slags. DOE

N82-10259# General Electric Co., St. Petersburg, Fla. Corporate Research and Development.
EXPERIMENTAL EVALUATION OF THE STEADY-STATE AND DYNAMIC PERFORMANCE CHARACTERISTICS OF THE INTERACTIVE UNITS OF A COAL-GASIFICATION PROCESS Quarterly Report, 28 Dec. 1980 - 29 Mar. 1981
J. C. Corman Apr. 1981 75 p refs
(Contract DE-AC01-80ET-14928)
(DE81-028995; DOE/ET-14928/1) Avail: NTIS HC A04/MF A01

The technology base required to premit coal conversion systems to operate within the constraints imposed by end use applications was investigated. A series of unfired dynamic tests along with fired steady state tests were defined. Thermal decomposition of ammonia was investigated. High conversion rates were observed for binary NH3/H2 gas mixtures. Conversion was found to be thermodynamically limited when substantial H2 and N2 concentrations are present. The overall structure of the IGCC mathematical model has been developed and information flow reqiements associated with each component in the model were defined. The computer model for the gasifier and the first water quench were completed. DOE

N82-10260# Hydrocarbon Research, Inc., Lawrenceville, N. J.
H-COAL PROCESS IMPROVEMENT STUDY. BENCH UNIT BASELINE RUN WITH PREHEATER/REACTOR
May 1981 56 p
(Contract DE-AC05-77ET-10152)
(DE81-026022; DOE/ET-10152/T6; FE-10152-65) Avail: NTIS HC A04/MF A01

The thermal dissolution of coal and its effects on the mechanism of coal liquefaction in an H-coal system is investigated. The two-stage coal liquefaction system consists of a coal slurry preheater which is essentially a short residence time reactor and a liquefaction reactor which can be regarded as a catalytic-hydrogenation-reactor. The preheater design and unit modifications

are discussed. Results of the run to obtain baseline data with the preheater integrated in the bench unit system are compared with those of previous bench runs at similar operating conditions without a preheater, and also to previous PDU operations at similar conditions. These comparisons were made to determine what effect a preheater has on product yields and product quality. It is concluded that a preheater tends to increase heavy liquid yields with more residual oil and a higher proportion of heavy distillates in the distillate product. DOE

N82-10262# Aluminum Co. of America, Pittsburgh, Pa.
PULVERIZED-COAL FIRING OF ALUMINUM MELTING FURNACES Quarterly Technical Progress Report, 1 Oct. - 31 Dec. 1979
C. E. West Oct. 1980 56 p refs
(Contract DE-AC01-78CS-40037)
(DOE/CS-40037/T2) Avail: NTIS HC A04/MF A01

Progress is reported on the demonstration program of an efficient, environmentally acceptable coal firing process suitable for implementation on melting furnaces in the aluminum industry. Specific tasks reported on are: design of burner A, process equipment design and layout, purchase of process equipment, and fabrication of burner A. The status report on phase I data deliverable and a cost summary are presented. DOE

N82-10263# Midwest Research Inst., Golden, Colo. Solar Energy Information Data Bank.
ALCOHOL FUELS BIBLIOGRAPHY, 1901 - MARCH 1980
Apr. 1981 468 p
(Contract DE-AC02-77CH-00178)
(DE81-025482; SERI/SP-751-902) Avail: NTIS HC A20/MF A01

This annotated bibliography is subdivided by subjects, as follows: general; feedstocks-sugar; feedstocks-starch; feedstocks-cellulose crops and residues; productions; coproducts; economics; use as vehicle fuel; government policies; and environmental effects and safety. DOE

N82-10264# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
CHEMISTRY AND MORPHOLOGY OF COAL LIQUEFACTION Quarterly Report, 1 Jan. - 30 Mar. 1981
Heinz Heinemann Mar. 1981 20 p
(Contract W-7405-eng-48)
(DE81-028899; LBL-12933) Avail: NTIS HC A02/MF A01

A novel cobalt mediated, reversible cleavage of a vinyl-hydrogen bond was discovered. All products from the thermal decomposition of tetralin were identified. The stereochemistry of cis-1, 2 dihydrotetralin was determined. In the utilization of the water gas shift reaction as a reducing agent for model coal compounds it was found that tributylphosphine ligands increase the life of transition metal hydride catalysts. Rates of demetallation of high metal content gas oils over cobalt-molybdena-alumina catalysts were measured for vanadium and iron. It is clearly shown that pore plugging of the catalyst occurs early and results in deposition of the metals on the external catalyst surface. DOE

N82-10267# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ENHANCEMENT OF METHANE GAS PRODUCTION USING AN INDUSTRIAL WASTE IN ANAEROBIC DIGESTION
L. Fradkin and F. Kremer (ESCOR, Inc.) 1980 10 p refs Presented at the 3rd Miami Intern. Conf. on Alternative Energy Sources, Fla., 15-18 Dec. 1980
(Contract W-31-109-eng-38)
(DE81-023819; CONF-801210-26) Avail: NTIS HC A02/MF A01

Chrominum can block enzymatic systems or interfere with essential cellular metabolites of most oxidizing bacteria. In general, heavy metals coagulate and precipitate proteins, many of which are denatured by this action. The effects on anaerobic digestion of chromium shavings from leather tanning were examined. Leather chrome shavings (which contain proteins, nitrogen, and fats) were added to two of three digesters at various rates. The methane gas production of the experimental units improved significantly compared to the control. In addition, the presence of a toxic loading or change of feed had no harmful effect on the digester performance. DOE

N82-10268# Mound Lab., Miamisburg, Ohio.
PRICETOWN 1 UNDERGROUND COAL GASIFICATION FIELD TEST: OPERATIONS REPORT
A. K. Agarwal and R. E. Zielinski 1981 269 p refs
(Contract DE-AC04-76DP-00053)
(DE81-025162; MLM-MU-81-62-0007) Avail: NTIS HC A12/MF A01

An Underground Coal Gasification (UCG) field test in bituminous coal was successfully completed near Pricetown, West Virginia. The viability of the linked vertical well (LVV) technology to recover the 900 foot deep, 6 foot thick coal seam was determined. A methane rich product gas with an average heating value of approximately 250 Btu/SCF was produced at low air injection flow rates during the reverse combustion linkage phase. Heating value of the gas produced during linkage enhancement phase was 221 Btu/SCF with air injection. The high methane formation was attributed to the thermal and hydrocracking of tars and oils along with hydropyrolysis and hydrogasification of coal char. The high heating value of the gas was the combined effect of residence time, flow pattern, injection flow rate, injection pressure, and back pressure. During the gasification phase, a gas with an average heating value of 125 Btu/SCF was produced with only air injection, which resulted in an average energy production of 362 MBtu/day. DOE

N82-10269# Aerojet Energy Conservation Co., Sacramento, Calif.
STUDY OF GELLED LNG Final Technical Report
M. I. Rudnicki, J. A. Cabeal, L. C. Hoffman, R. A. Newton, R. K. Schaplowsky, and E. M. VanderWall May 1981 110 p
(Contract DE-AC03-80SF-10846)
(DE81-023259; DOE/TIC-11452) Avail: NTIS HC A06/MF A01

Progress is reported in the following areas: characterization of gelled LNG (GELNG) rheological properties, assessment of the relative leakage of GELNG vs LNG through a perforated wall, relative spread and vaporization rates of unconfined spills on water, and relative spread and vaporization rates of unconfined spills on land. Shear stress vs strain rate was determined for a range of gelant concentrations. The shear diagram was extended to cover shear rates in the range of 13 to 14,800 inverse seconds, expanding previous results at both low and high shear rates. Leakage tests of GELNG through a known geometry perforation were conducted along with comparative testing with LNG. Rapid cessation of flow through the perforated plate was observed for all tested concentrations of GELNG and at all driving pressures. Land spills were found to give inconclusive results due to difficulties in measuring transient weight changes during the spill. Gelatin increases total vaporization time significantly in water spills. DOE

N82-10271# Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Group.
SELECTIVITY IN FISCHER-TROPSCH SYNTHESIS: REVIEW AND RECOMMENDATIONS FOR FURTHER WORK
L. Caldwell Jun. 1980 42 p refs
(PB81-223596; CSIR-SR-CHNG-330) Avail: NTIS HC A03/MF A01 CSCL 21D

A broad product spectrum is obtained from the Fischer-Tropsch synthesis aimed at the production of gasoline and diesel fuels. This is a consequence of the carbon atom by carbon atom mechanism of chain growth. There is potential for narrowing the product spectrum by use of dual-function catalysts or transient process conditions. GRA

N82-10272# Battelle Pacific Northwest Labs., Richland, Wash.
KINETICS AND CATALYSIS OF PRODUCING SYNTHETIC GASES FROM BIOMASS Annual Report, 7 Dec. 1979 - 6 Dec. 1980
L. J. Sealock, Jr., D. C. Elliott, S. L. Weber, and R. J. Robertus Jan. 1981 129 p refs
(Contract GRI-5014-361-0242)
(PB81-217614; GRI-79-0100) Avail: NTIS HC A07/MF A01 CSCL 21D

The kinetics, reaction sequences, and pathways involved in pyrolysis and catalytic steam gasification of wood and wood components were investigated. An autoclave and a batch reactor were used to study gasification at low temperature and high temperature regimes. Kinetic studies of the carbon steam reaction relative to cellulose and lightning gasification were completed. Reaction rate constants and activation energies were determined for three catalyzed cases and for a noncatalyzed case. The formation of specific compounds during gasification in the presence and absence of catalyst was investigated in both reactor systems. Results of the experiments demonstrate dramatic effects on the

kinetics and gas composition as a function of the various catalyst and catalyst concentrations tested. GRA

N82-10275# Air Products and Chemicals, Inc., Trexlertown, Pa.
LOAD-CHANGE TESTING OF A LARGE COMMERCIAL OXYGEN PLANT Final Report
N. Chatterjee, J. C. Sorensen, and A. J. Patrylak Apr. 1981 46 p refs
(EPRI Proj. 2806-1)
(EPRI-NP-1824) Avail: NTIS HC A03/MF A01

A series of transient response tests were successfully conducted on one of three 1,000 T/D oxygen production plants operated under computer control. These tests involved a series of rapid rate changes in oxygen production specified to simulate the varying demand for oxygen of a coal gasifier in combined cycle power generation service. Since the ability of the oxygen plant itself to rapidly change its gaseous production rate is an important element in the design and operation of gasification combined cycle) plants, a series of load following tests was arranged. The actual oxygen plant rate changes easily exceeded the targeted response rate with minimal variation in product oxygen purity. Oxygen production rate changes of +- 10 to +- 13% of design in 1 to 2 min were readily accomplished. The production rate was also varied over the full range from 70% to 105% of design at a continuous ramp rate of approximately 2% of design production per minute. DOE

N82-10279# Ruhrkohle A.G., Essen (West Germany).
SAFETY AND TECHNICAL OPTIMIZATION OF BELT TRANSFER POINTS WITH SPECIAL CONSIDERATION FOR THE SUPPRESSION OF NOXIOUS AND EXPLOSIVE DUSTS Final Report
Albert Schade Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-HA-80-048; ISSN-0171-7618) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 14,90

A dust suppression installation and a dust monitoring instrument were laboratory tested and installed at belt transfer points in a coal plant where noxious and explosive dust develops by air separation, leading to considerable increases of concentration in subsequent operational areas. Usage of enclosed segment chutes is shown to reduce the dust load by 40%. A digital scattered light photometer in connection with a signal-controlled sprinkler installation lead to further dust diminution along with a reduction of the spray water volume by 30 to 50%. Generalization of usage of the present installation is advocated.
Author (ESA)

N82-10366# Brown Univ., Providence, R. I. Div. of Engineering.
FLOW IN GEOTHERMAL WELLS. PART 4: TRANSITION CRITERIA FOR TWO-PHASE FLOW PATTERNS
Z. Bilicki and J. Kestin Dec. 1980 22 p refs
(Contract DE-AC02-79ET-27225)
(DE81-028312; DOE/ET-27225/9) Avail: NTIS HC A02/MF A01

Detailed considerations justifying the criteria for transitions between flow patterns are presented. The following are covered: transition from bubble to plug (or slug) flow, transition from plug flow to froth flow, transition from froth to annular mist flow, and model comparisons. DOE

N82-10474# Department of Energy, Washington, D. C. Energy Information Administration.
VENEZUELA, TRINIDAD AND TOBAGO: CRUDE OIL POTENTIAL FROM KNOWN DEPOSITS
William D. Dietzman, Naim R. Rafidi, and Arthur J. Warner Jul. 1981 127 p refs
(DE81-027023; DOE/EIA-0297) Avail: NTIS HC A07/MF A01

Estimates of original oil in place; ultimate recovery; remaining reserves; and projected supply patterns are presented. A discussion of the methodology for projecting supply patterns is also presented. The Republic of Venezuela ranked 7th in 1979 in production among the oil producers of the world and is one of the leading exporters of crude oil. About 1/3 of the country's exports are received by the United States, and it was the 5th and 3rd largest supplier of crude oil and refined products to the United States in 1978 and 1979, respectively. DOE

N82-10475# Nevada Univ., Reno.
LOW-TO-MODERATE TEMPERATURE GEOTHERMAL RESOURCE ASSESSMENT FOR NEVADA, AREA SPECIFIC STUDIES Final Report, 1 Jun. 1980 - 30 Aug. 1981
D. T. Trexler, B. A. Koenig, T. Flynn, J. L. Bruce, and G. Ghusn, Jr. 1981 223 p refs
(Contract DE-AC08-79NV-10039)
(DE81-030487; DOE/NV-10039/3) Avail: NTIS HC A10/MF A01

The Hawthorne study area encompasses approximately 310 sq km. The energy needs of the military and the local population are substantial. The techniques employed in the resource assessment are described. Geological and geophysical methods were used and the results are reported. T.M.

N82-10477# Texas Univ., Austin. Dept. of Petroleum Engineering.
TERTIARY OIL RECOVERY PROCESSES RESEARCH AT THE UNIVERSITY OF TEXAS Final Report, Oct. 1979 - Sep. 1980
R. S. Schechter and W. H. Wade Jun. 1981 135 p refs
(Contract DE-AC19-78BC-20001)
(DE81-025222; DOE/BC-20001/10) Avail: NTIS HC A07/MF A01

Surfactant adsorption, phase behavior, interfacial tension, and solubilization were examined. Focus is on solubilization, I.F.T., and phase behavior with the emphasis on the influence of branching for anionics and molecular weight for nonionics. Phase behavior is related to emulsion stability, polymeric surfactants, and salinity tolerant surfactants were evaluated. DOE

N82-10478# Oak Ridge National Lab., Tenn.
ION EXCHANGE CHARACTERISTICS OF ENHANCED OIL RECOVERY SYSTEMS (MISCIBILITY STUDIES) Semiannual Report, 1 Apr. 1979 - 30 Sep. 1980
P. C. Ho, K. A. Kraus, T. M. Bender, and S. B. Ogden Jul. 1981 59 p refs
(Contract W-7405-eng-26)
(DE81-769734; DOE/BETC/OR-19) Avail: NTIS HC A04/MF A01

During the report period: (1) studies of the hydrotropic properties of organic alkylbenzenesulfonates and particularly of alkylbenzenecarboxylates were extended; (2) the effects of several different alcohols on miscibility between aqueous protosurfactant solutions and aliphatic and aromatic alkanes were investigated; (3) hydrotropic properties of an alicylic carboxylate were determined; (4) the equivalent weight of the organic salts studied was extended into the surfactant range; (5) solubilities of protosurfactants and surfactants in salt solution were measured; and (6) investigations of the adsorption of protosurfactants on minerals as a function of salinity were started. Measurements include establishment of the phase behavior in the limiting three-component systems, the effect of protosurfactant concentration in the four-component systems, and determination of the compositions in a limited number of cases of the coexisting phases. DOE

N82-10479# Argonne National Lab., Ill. Land Reclamation Program.
FRACTURE FLOW OF GROUNDWATER IN COAL-BEARING STRATA
Jeffrey P. Schubert 1980 15 p refs Presented at 1980 Symp. on Surface Mining Hydro., Sedimentology and Reclamation, Lexington, Ky., 1-5 Dec. 1980
(Contract W-31-109-eng-38)
(DE81-023810; CONF-801263-1) Avail: NTIS HC A02/MF A01

Laboratory tests on core samples of sandstones, siltstones, shales, and claystones indicate extremely low intergranular hydraulic conductivities. Various aquifer tests, using wells in the same locations, invariably showed hydraulic conductivities to be much greater than those estimated by laboratory techniques. In addition the hydraulic conductivity of highly fractured rock can be 100 to 1,000 times greater than slightly fractured rock. The greatest concentration of fractures usually occurs in faulted areas and in narrow fracture zones less than 100 m below ground surface. The majority of large inflows through rock into surface and underground mines occur at the faults and fracture zones. By studying and understanding more about the structural control

of fractures in coal basins, the larger inflows possibly could be avoided. DOE

N82-10480# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT OF MAN-MADE GEOTHERMAL RESERVOIRS
Roland A. Pettitt 1981 9 p Presented at the Energy in the Man-Built Environment: The Next Decade Specialty Conf., Vail, Colo., 3-5 Aug. 1981
(Contract W-7405-eng-36)
(LA-UR-81-852) Avail: NTIS HC A02/MF A01

The technology used to create and extract heat from a geothermal reservoir in low porosity, granitic basement rock in at the Fenton Hill site in northern New Mexico is described. Topics covered include drilling boreholes, injecting potable water as the working fluid, hydraulic fracture to provide the large surface area need for heat exchange, the mechanics of reservoir growth, make-up water requirements, geofluid chemistry, electrical generation, operational constraints, and effects on the environment. A.R.H.

N82-10482# Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (West Germany).
DEVELOPMENT OF ORGANIC GEOCHEMICAL AND ISOTOPE TECHNIQUES FOR HYDROCARBON EXPLORATION Final Report
Eckhard Faber, Heinz Hufnagel, Helmut Jacob, Joachim Kock, Wolfgang Stahl, Manfred Teschener, and Hermann Wehner Bonn Bundesministerium fuer Forschung und Technologie Oct. 1980 55 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-076; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11.55

Sedimentary organic matters was characterized by correlating microscopic and chemical data. Techniques for oil-oil and oil-source rock correlations were developed using the distribution of polycyclic aromatic hydrocarbons. It is shown that the carbon isotopic composition of oils, extracts and kerogens. The C12/C13 ratios of methane from different natural gases were correllated with the maturity of their source rocks. The C13/C12 ratios of methane from cuttings were also determined. Results show that pyrolysis chromatograms reflect the type of organic matter. Fluorescence of dinoflagellates is directly related to maturity. Bitumens are classified by fluorescence microscopy. Correlation of crude oils is performed using chromatograms of the aromatic fraction of crudes. Gas-source rock correlation is feasible by a systematic correlation of delta values of methane and the maturity of the source organic matter. Isotope analyses of head-space gases are developed for active exploration. Author (ESA)

N82-10560# Los Alamos Scientific Lab., N. Mex.
HOT DRY ROCK GEOTHERMAL ENERGY DEVELOPMENT PROGRAM Progress Report
Paul R. Franke 1981 17 p refs Presented at the IECEC Conf., Atlanta, 19 Aug. 1981
(Contract W-7405-eng-36)
(LA-UR-81-1265; CONF-810812-11) Avail: NTIS HC A02/MF A01

A hot dry rock geothermal system was developed from a reservoir created by hydraulic fracturing. A reservoir of sufficient size and capacity was confirmed and two extraction runs were made. The thermal drawdown data indicate that the effective heat area is increased. The reservoir enlargement is confirmed by gradual thermal drawdown, and the effective heat transfer area of the reservoir is increased. E.A.K.

N82-10655# Pacific Northwest Lab., Richland, Wash. Atmospheric Sciences Dept.
ANALYSIS OF DATA FROM THE US DEPARTMENT OF ENERGY'S METEOROLOGICAL VALIDATION PROGRAM
William F. Sandusky and John W. Buck Jun. 1981 19 p refs Presented at the Pacific Div., Am. Assoc. for the Advan. of Sci. Ann. Meeting, Richland, Wash., 15-18 Jun. 1981
(Contract DE-AC06-76RL-01830)
(DE81-030100; PNL-SA-9411; CONF-8106152-1) Avail: NTIS HC A02/MF A01

The history of the meteorological validation program (MVP) and its unique features of the summarized data for candidate sites are described. Available wind power for each site and the projected power for a MOD-2 turbine at each site is provided. Wind power data are compared to data from the resource assessment program to locate areas of high wind energy potential in the contiguous United States, Alaska and Puerto Rico. The effect of data recording techniques and averaging period of the data on Weibull distribution parameters are included. DOE

N82-10735# British Gas Corp., Newcastle-upon-Tyne (England). Engineering Research Station.
MICROPROCESSOR APPLICATIONS FOR THE MONITORING AND CONTROL OF GAS SUPPLIES
R. S. Davidson and T. M. Sporton Nov. 1980 11 p Presented at IMEKO/IFAC Symp. on Appl. of Microprocessors in Devices for Instrumentation and Automatic Control, London, 17-20 Nov. 1980
(ERS-E-276) Avail: NTIS HC A02/MF A01

The potential of the microprocessor to replace many established electromechanical and pneumatic systems and to solve problems which could be tackled previously only by main-frame comouters is discussed. Applications already in use and ideas under development are detailed. These include telemetry systems used for controlling and monitoring gas supplies, controlling the monitoring of a reversible liquid natural gas process for meeting peak demand on a seasonal basis, a system incorporating a microprocessor for gas holder monitoring and control, and a prototype microprocessor control system for gas distribution governors. Author (ESA)

N82-10938# Battelle Columbus Labs., Ohio
THERMOPHYSICAL PROPERTIES OF COAL LIQUIDS Quarterly Technical Status Report, 1 Apr. - 30 Jun. 1981
J. W. Droege, R. Venkateswar, and S. P. Chauhan 17 Jul. 1981 40 p
(Contract DE-AC22-79ET-14941)
(DE81-0279446; BMI-2086; QTSR-7) Avail: NTIS HC A03/MF A01

The rheological properties of coarse coal which grind at relatively low temperature (450 K) showed a substantially lower viscosity. It is also shown that coal and solvent from a plant give slurries of much higher viscosity than slurries from reference coal and solvent. The same relationships are shown at higher temperatures. The effect of solvent to coal ratio is also very great. Differential scanning calorimetry give low reliability specific heat results and a probable heat effect at about 500 K is shown. DOE

N82-10939# Colorado School of Mines, Golden.
ENTHALPY MEASUREMENT OF COAL-DERIVED LIQUIDS Technical Progress Report, May - Jun. 1981
A. J. Kidnay and V. F. Yesavage 15 Jul. 1981 14 p
(Contract DE-AC22-81PC-40787)
(DE81-029481; DOE/PC-40787/1) Avail: NTIS HC A02/MF A01

Enthalpy for coal derived liquids on the model compound quinoline was measured. Compounds over the pressure and temperature and temperature regions encountered in liquification and processing systems were modeled. Preliminary results are presented for the temperature region 186 to 7320 F along isobars of 75, 100, and 200 psia. DOE

N82-11144* National Aeronautics and Space Administration. Pasadena Office, Calif.
FLUIDIZED BED COAL COMBUSTION REACTOR Patent
Philip I. Moynihan (JPL, California Inst. of Technology, Pasadena) and Donald L. Young, inventors (to NASA) (JPL, California Inst. of Technology Pasadena) Issued 8 Sep. 1981 7 p Filed 15 Dec. 1978 Supersedes N79-14388 (17 - 05, 0801)
Sponsored by NASA
(NASA-Case-NPO-14273-1; US-Patent-4,287,838; US-Patent-Appl-SN-969759; US-Patent-Class-110-234; US-Patent-Class-110-255; US-Patent-Class-110-266; US-Patent-Class-110-245; US-Patent-Class-122-4D) Avail: US Patent and Trademark Office CSCL 21B

A fluidized bed coal reactor includes a combination nozzle-injector ash-removal unit formed by a grid of closely spaced open channels, each containing a worm screw conveyor, which function as continuous ash removal troughs. A pressurized air-coal mixture is introduced below the unit and is injected through the elongated nozzles formed by the spaces between the channels. The ash build-up in the troughs protects the worm screw conveyors as does the cooling action of the injected mixture. The ash layer and the pressure from the injectors support a fluidized flame combustion zone above the grid which heats water in

boiler tubes disposed within and/or above the combustion zone and/or within the walls of the reactor.
Official Gazette of the U.S. Patent and Trademark Office

N82-11148*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COAL DESULFURIZATION BY LOW TEMPERATURE CHLORINOLYSIS, PHASE 3 Technical Report, 1 Mar. 1980 - 1 Mar. 1981
John Kalvinskas, Naresh Rohatgi, and John Ernest 1 Mar. 1981 170 p refs Sponsored by NASA
(Contract DE-AI01-77ET-12547)
(NASA-CR-164957; JPL-Pub-81-82; DOE/ET-12547/1) Avail: NTIS HC A08/MF A01 CSCL 07D

Laboratory scale, bench scale batch reactor, and minipilot plant tests were conducted on 22 bituminous, subbituminous, and lignite coals. Chemical pretreatment and post treatment of coals relative to the chlorination were tried as a means of enhancing desulfurization by the chlorinolysis process. Elevated temperature (500-700 C) hydrogen treatment of chlorinolysis-processed coal at atmospheric pressure was found to substantially increase coal desulfurization up to 90 percent. Sulfur forms, proximate and ultimate analyses of the processed coal are included. Minipilot plant operation indicates that the continuous flow reactor provides coal desulfurization results comparable to those obtained in the batch reactor. Seven runs were conducted at coal feed rates of 1.5 to 8.8 kg per hour using water and methylchloroform solvents, gaseous chlorine feed of 3 to 31.4 SCFH at 21 to 70 C, and atmospheric pressure for retention times of 20 to 120 minutes.
Author

N82-11148*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ASSESSMENT OF ADVANCED COAL GASIFICATION PROCESSES
John McCarthy, Joseph Ferrall, Thomas Charng, and John Houseman Jun. 1981 200 p refs Sponsored in part by DOE and JPL
(Contracts NAS7-100; DE-AI21-77ET-13032; JPL Proj. 5030-470)
(NASA-CR-164949; JPL-Pub-81-45; DOE/ET-13032/2) Avail: NTIS HC A09/MF A01 CSCL 07D

A technical assessment of the following advanced coal gasification processes is presented: high throughput gasification (HTG) process; single stage high mass flux (HMF) processes; (CS/R) hydrogasification process; and the catalytic coal gasification (CCG) process. Each process is evaluated for its potential to produce synthetic natural gas from a bituminous coal. Key similarities, differences, strengths, weaknesses, and potential improvements to each process are identified. The HTG and the HMF gasifiers share similarities with respect to: short residence time (SRT), high throughput rate, slagging, and syngas as the initial raw product gas. The CS/R hydrogasifier is also SRT, but is nonslagging and produces a raw gas high in methane content. The CCG gasifier is a long residence time, catalytic, fluidbed reactor producing all of the raw product methane in the gasifier.
S.L.

N82-11149# Babcock and Wilcox Co., Alliance, Ohio. Research and Development Div.
COMPUTATIONAL TOOLS FOR PULVERIZED-COAL COMBUSTION Quarterly Report, Mar. - Jun. 1981
W. J. Oberjohn, W. Fiveland, D. K. Cornelius, J. H. Wang, and R. J. Schnipke Jul. 1981 144 p refs
(Contract DE-AC22-81PC-40265)
(DE81-028582; DOE/PC-40265/1; QR-1) Avail: NTIS HC A07/MF A01

A computer code capable of modeling the major aspects of pulverized coal combustion was developed. The combustion model (COMO) consists of a number relatively independent modules that represent the major processes involved in pulverized coal combustion. Version one of COMO is used primarily to determine a satisfactory means of integrating the numerical models of the combustion processes into an overall combustion model. Detailed task descriptions were prepared, literature searches conducted, and process models selected for version one. The formulation and coding of the models was initiated and, in some cases, comparisons with data and other predictions were made. Code development guidelines were prepared and reviewed. The guidelines present the information required to allow process modules to be developed relatively independently, while providing for the subsequent integration of these modules into COMO.
DOE

N82-11149# Battelle Pacific Northwest Labs., Richland, Wash.
TECHNIQUES FOR GEOTHERMAL LIQUID SAMPLING AND ANALYSIS
C. H. Kindle and E. M. Woodruff Jul. 1981 102 p refs
(Contract DE-AC06-76RL-01830)
(DE81-030151; PNL-3801) Avail: NTIS HC A06/MF A01

A methodology was developed that is particularly suited to liquid-dominated resources and adaptable to a variety of situations. It is intended to be a base methodology upon which variations can be made to meet specific needs or situations. The approach consists of recording flow conditions at the time of sampling, a specific insertable probe sampling system, a sample stabilization procedure, commercially available laboratory instruments, and data quality check procedures.
DOE

N82-11151# Oak Ridge National Lab., Tenn. Engineering Div.
TENNESSEE VALLEY AUTHORITY ATMOSPERIC FLUIDIZED-BED COMBUSTOR SIMULATION Interim Annual Report, 1 Jan. - 31 Dec. 1980
J. W. Wells, M. H. Culver (Georgia Inst. of Technology), and R. P. Krishman Sep. 1981 263 p refs
(Contract W-7405-eng-26)
(DE81-030262; ORNL/TM-7847) Avail: NTIS HC A12/MF A01

The development of a steady-state mathematical model with the capability of predicting trends in bed performance under various feed and operating conditions is discussed. Three additional predictive subcodes were developed: the SO2 capture subcode, the NO/sub x/ emissions subcode, and the freeboard subcode. The following subcodes were combined to form an overall simulation code of the AFBC bed: (1) bubble growth subcode; (2) elutriation-attrition subcode; (3) coal combustion subcode; (4) SO2 capture subcode; and (5) NO/sub x/ emissions subcode. An energy balance routine was added to the combined code. The resulting overall bed simulation is capable of predicting how some of the important operating variables affect AFBC's performance. The freeboard model was combined with the overall bed simulation and is currently being debugged.
DOE

N82-11152# Illinois Univ. at Chicago Circle, Chicago.
VERTICAL COMBUSTOR FOR REFUSE COMBUSTION
Paul M. Chung Jun. 1981 64 p refs Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE81-030002; ANL/CNSV-TM-80) Avail: NTIS HC A04/MF A01

A vertical combustor for refuse-particle combustion was analyzed for waste-to-energy recovery. A one dimensional model was constructed that consisted of fuel particles, inert solid particles, and the gaseous mixture. The gaseous mixture was divided further into six chemical species that are involved in combustion at temperatures below about 2000 F. It was concluded that such combustors may be viable in the United States since US refuse contains large amounts of volatile matter. Combuston of the relatively small char, however, may not be cost-effective in the present combustor where the fuel residence time is on the order of 2 s for a combustor height of 20 to 30 ft. A computer solution was designed to optimized a given combustor system. A simplified version of the solution was programmed for a TI-59 programmable hand calculator for field use.
DOE

N82-11153# Stanford Univ., Calif. Petroleum Research Inst.
ALGORITHM FOR COMPUTING IN-SITU COMBUSTION OIL RECOVERY PERFORMANCE
Mohammad R. Fassihi, Brian D. Gobran, and Henry J. Ramey, Jr. Oct. 1981 29 p refs
(Contract DE-AC03-76ET-12056)
(DE81-030340; DOE/ET-12056/25; SU-SUPRI-TR-25) Avail: NTIS HC A03/MF A01

An algorithm was developed to estimate the in-situ combustion performance in the field. A calculator program was prepared using this algorithm. The program is efficient, simple and accurate. Given estimates of fuel concentration, air/fuel ratio, gas and oil saturations, and injection rate, for each volume burned, oil recovery, air requirement, and time may be calculated.
DOE

N82-11154# Massachusetts Inst. of Tech., Oak Ridge, Tenn. School of Chemical Engineering Practice.
ALUMINUM RECOVERY FROM FLY ASH AND SHALE-RETORT WASTES
J. L. Plawsky, R. K. Helling, and M. E. Tsui Jul. 1981 72 p refs
(Contract W-7405-eng-26)
(DE81-027675: ORNL/MIT-331) Avail: NTIS HC A04/MF A01

The sparge-crystallization step in a proposed process for aluminum recovery from fly ash was studied. The effect of various feeds and HCl concentration on the solubility of six metal ions was investigated, and the yield and purity of the crystals obtained. Significant improvements in data consistency were obtained over previous work on this system. Multistage crystallization and washing will be necessary to achieve removal of K and Mg to meet product specification. The replacement of ferric ion with ferrous ion produced an increase in Mg solubility, leading to the conclusion that more work is required with ferrous feeds and with multistage crystallizations. Experiments with leachate from oil-shale-retort residues produced 99.87% aluminum purity. A predictive correlation proposed by Meissner was used to predict solubilities of pure and mixed salts in hydrochloric acid solutions. Modification of the correlation's parameters yielded excellent agreement with theory for the AlCl3-HCl system. DOE

N82-11158# Polytechnic Inst. of New York, Farmingdale. Aerodynamics Labs.
ONE-DIMENSIONAL EQUILIBRIUM-CHEMISTRY FLOW MODEL FOR COAL COMBUSTORS
P. M. Sforza, M. Smorto, and W. Peter May 1981 108 p refs
(Contracts DE-AC01-78ET-11056; ET-78-C-01-3084)
(DE81-027622; DOE/ET-11056/T5; POLY-M/AE-81-8) Avail: NTIS HC A06/MF A01

A quasi one dimensional steady flow analysis for high temperature coal combustors was developed. Results for the case of global heat release based on fuel heating value were compared to those obtained with a finite rate chemical reaction combustor analysis and reasonable agreement between the two was demonstrated. An existing chemical equilibrium computer code was then coupled to the one dimensional gas dynamic code to improve the accuracy of the required thermodynamic and chemical input data; the coupled code is called COMBUSTOR. The second stage or a coal fired MHD combustor designed for large scale operation was modeled by means of the COMBUSTOR code for cases with and without heat transfer, and for varying amounts of potassium carbonate seed injection. Results for combustor exit temperature, composition, velocity, and electrical conductivity from the model are shown to agree well with those obtained in the operational combustor DOE

N82-11164# AeroChem Research Labs., Inc., Princeton, N. J.
SOOT FORMATION IN SYNFUELS Quarterly Report, 1 Jan. - 31 Mar. 1981
D. B. Olson Aug. 1981 21 p refs Prepared in cooperation with the Pittsburgh Energy Technology Center, Pa.
(Contract DE-AC22-80PC-30304)
(DE81-030273; DOE/PC-30304/2; QR-2) Avail: NTIS HC A02/MF A01

An experimental program is underway to study the effects of molecular structure, pressure, and temperature on soot production in laboratory flames of selected synfuel component hydrocarbons. The objective of Task I is to measure the Threshold Sooting Index, flame temperature, and soot concentration for some 50 fuels in premixed and diffusion flames. During this reporting period a new liquid metered fuel vaporizer was built and tested to replace a boiler-type fuel system that failed to perform adequately. The three wavelength optical probe for measuring emission temperatures and soot concentrations was built and calibrated against a tungsten lamp. Sampling probes for the mass spectrometer being used in Task II for flame structure analysis were tested this period. The 900 stainless steel sampling probes failed due to overheating to 1200 probes were built (with thicker walls and a higher temperature steel alloy). A new electrostatic lens system to focus the flame ions into the mass filter was also built and installed in the apparatus. Author

N82-11165# Gulf Research and Development Co., Pittsburgh, Pa.
INVESTIGATION OF MECHANISMS OF HYDROGEN TRANSFER IN COAL HYDROGENATION Annual Progress Report, Feb. 1980 - Feb. 1981
D. C. Cronauer, R. J. McNeil, D. C. Young, and R. G. Ruberto Jul. 1981 72 p refs
(Contract DE-AC22-80PC-30080)
(DE81-030492: DOE/PC-30080/4) Avail: NTIS HC A04/MF A01

Hydrogen transfer experiments using Powhatan No. 5 bituminous coal (Pittsburgh Seam) and labeled solvents are complete. The liquefaction runs with d4-tetrain were made at temperatures of 300 to 4500 C and at run times of 0, 10 and 30 min; additional runs were made with d12-tetrahn at 400 and 4500 C. Product samples were examined by (2)H-NMR to observe the site of deuterium transfer. The relative distribution of deuterium was primarily influenced by reaction temperature and not run time in spite of a major change in the absolute amount of hydrogen transfer with run time. Much of bituminous coal liquefaction occurs during the reactor heat-up time even though a low level of hydrogen transfer occurs. Therefore, the subsequent hydrogen (deuterium) distribution is strongly influenced by up-grading type reactions that occur. Hydrogen/deuterium exchange occurs to a sizable level at the severe conditions of coal liquefaction; this strongly affects the distribution of deuterium in the products. This exchange is enhanced by the pressure of heavy aromatic species and by mineral matter and unconverted coal solids. DOE

N82-11166# Virginia Polytechnic Inst. and State Univ., Blacksburg.
DEVELOPMENT AND APPLICATION OF ANALYTICAL TECHNIQUES TO CHEMISTRY OF DONOR SOLVENT LIQUEFACTION Quarterly Progress Report, Apr. - Jun. 1981
H. C. Dorn and L. T. Taylor Aug. 1981 19 p refs
(Contract DE-AC22-80PC-30041)
(DE81-029125: DOE/PC-30041/T6) Avail: NTIS HC A02/MF A01

On-line IC-(h-1) nmr analysis of coal recycle solvents is presented. This technique is also complimented with a gas chromography-mass spectroscopic analysis of off-line LC fractions. DOE

N82-11167# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
DEVELOPMENT AND APPLICATION OF ANALYTICAL TECHNIQUES TO CHEMISTRY OF DONOR SOLVENT LIQUEFACTION Quarterly Progress Report, Jan. - Mar. 1981
H. C. Dorn and L. T. Taylor Jul. 1981 20 p refs
(Contract DE-AC22-80PC-30041)
(DE81-025961: DOE/PC-30041/T5) Avail: NTIS HC A02/MF A01

The operation of modern superconducting magnet based spectrometers in the liquid chromatography-proton nuclear magnetic resonance spectroscopy (LC-(1)H) NMR mode is fairly simple. In light of the considerable improvements made in this technique, LC-(1)H NMR has shown itself to be quite useful in fuel analysis. The limits of detection are now sufficiently low to be near that of the refractive index detector. Improvements in resolution (both chromatographic and spectroscopic) have made speciation within a class possible. The LC-(1)H NMR technique increases the convenience and reliability of determining the average degree of substitution. Results are reported of runs made on a jet fuel and a model mixture which was prepared by mixing n-butylbenene, m-xylene, tetralin, naphthalene, dodecane, isooctane, n-hexane, nonane, hexadecane and n-pentane. DOE

N82-11168# Air Products and Chemicals, Inc., Allentown, Pa.
CATALYST AND REACTOR DEVELOPMENT FOR A LIQUID-PHASE FISCHER-TROPSCH PROCESS Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1981
J. W. Brockington, Paul N. Dyer, Ronald Pierantozzi, Barry W. Brian, and Jeffrey V. Bauer Apr. 1981 47 p refs
(Contract DE-AC22-80PC-30021)
(DE81-028209: DOE/PC-30021/T4) Avail: NTIS HC A03/MF A01

The computerized literature search of Fischer-Tropsch literature was continued, refinements in analytical procedures were implemented, the first 300 mL slurry reactor was completed, and catalyst screening tests were begun in the 15 mL gas-phase tubular reactor. Two of ten modified conventional slurry catalysts

were prepared. Two batches of one of these catalysts, representing different pretreatment procedures, and a baseline Fischer-Tropsch catalyst were tested in the gas phase reactor. Eight metal cluster catalysts were screened in a gas phase reactor. Construction of the cold flow reactor simulator was completed and initial experiments begun. The persistant foaming problem associated with the use of kerosene as a cold flow liquid was overcome by using a C (9)-C11 isoparaffin mixture instead of kerosene.
DOE

N82-11169# Argonne National Lab., Ill. Fossil Energy Program Dept.
MATERIALS TECHNOLOGY FOR COAL-CONVERSION PROCESSES Progress Report, Jan. - Mar. 1981
W. A. Ellingson Jun. 1981 47 p refs
(Contract W-31-109-eng-38)
(DE81-028474; ANL-81-30) Avail: NTIS HC A03/MF A01

Microprobe studies of reaction layers on refractories exposed to a high (20 wt percent) iron oxide acidic coal slag suggest that the amount of iron oxide in the reaction layer immediately adjacent to the slag increases significantly as the chromia content in the refractory increases. Waveguides were installed at the SRC pilot plant to monitor erosive wear. Installation of the ANL-designed erosion scanner at the Exxon Coal Liquefaction Pilot Plant was completed. Nondestructive tests of the HYGAS high-pressure cyclone separator showed that the cyclone internal cone has eroded through in some areas. Evaluation of wear of the METC tar-separator cyclones and solids-separator cyclone continued; the addition of B4C hardfacing has reduced the wear rate in one of the tar cyclones. Preliminary tests were conducted on the capability of an electromagnetic acoustic transducers to measure wall thickness. Work on passive acoustic methods to detect leaks in block valves continued. Work continued to evaluate the effect of combustion gas stoichiometry and deposits on the corrosion behavior of air and steam heat-exchanger tubes. Results indicate that high-chromium alloys such as Type 310 stainless steel exhibit a protective Cr oxide layer in the absence of a deposit.
DOE

N82-11224*# Lockheed-California Co., Burbank.
EXPERIMENTAL STUDY OF FUEL HEATING AT LOW TEMPERATURES IN A WING TANK MODEL, VOLUME 1 Final Report
Francis J. Stockemer Aug. 1981 75 p refs
(Contract NAS3-21977)
(NASA-CR-165391; LR-29936-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 21D

Scale model fuel heating systems for use with aviation hydrocarbon fuel at low temperatures were investigated. The effectiveness of the heating systems in providing flowability and pumpability at extreme low temperature when some freezing of the fuel would otherwise occur is evaluated. The test tank simulated a section of an outer wing tank, and was chilled on the upper and lower surfaces. Turbine engine lubricating oil was heated, and recirculating fuel transferred the heat. Fuels included: a commercial Jet A; an intermediate freeze point distillate; a higher freeze point distillate blended according to Experimental Referee Broadened Specification guidelines; and a higher freeze point paraffinic distillate used in a preceding investigation. Each fuel was chilled to selected temperature to evaluate unpumpable solid formation (holdup). Tests simulating extreme cold weather flight, without heating, provided baseline fuel holdup data. Heating and recirculating fuel increased bulk temperature significantly; it had a relativley small effect on temperature near the bottom of the tank. Methods which increased penetration of heated fuel into the lower boundary layer improved the capability for reducing holdup.
S.L.

N82-11228# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Fuels and Lubrication Div.
JET FUEL LOCKS TO SHALE OIL: THE 1980 TECHNOLOGY REVIEW
Herbert R. Lander May 1981 156 p refs Proceedings of Conf. held at Cincinnatti, 19-20 Nov. 1980
(AF Proj. 2480)
(AD-A104414; AFWAL-TR-81-2063) Avail: NTIS HC A08/MF A01 CSCL 11/4

The progress of several Air Force shale oil related programs is reported. Three shale oil processing studies evaluating the yield, cost, and quality of JP-4 and JP-8 turbine fuel produced from whole crude shale oil are discussed. Details of a fourth program that produced 11,300 gallons of specification JP-4 from Geokinetics shale oil are reported. Some of this jet fuel was tested in Air Force Fuel Mainburner/Turbine Effects Programs and was shown to behave very similar to petroleum derived JP-4. An additional study concentrated on developing hydrotreating catalysts that would more efficiently convert shale oil into aviation turbine fuel.
Author (GRA)

N82-11231# Naval Ship Research and Development Center, Annapolis, Md. Ship Materials Engineering Dept.
OUTGASSING OF TWO SYNTHETIC FUELS Final Report
Peter Demas Sep. 1981 25 p refs
(ZF43451001)
(AD-A104580; DTNSRDC/SME-80/48) Avail: NTIS HC A02/MF A01 CSCL 21/4

The outgassing characteristics of two synthetic fuels proposed for Navy use were investigated to determine whether potentially toxic gases could be released into ships' atmospheres. The synthetic fuels studied were: (1) shale diesel fuel W-375 prepared to conform to MIL-F-16884G and (2) shale jet fuel W-383 prepared to conform to MIL-T-5624K. These outgassing characteristics of the synthetic fuels were compared to the outgassing characteristics of a conventional petroleum fuel conforming to MIL-16884G obtained from USS PONCE (LPD 15). Single samples of each fuel were sequentially exposed to temperatures of 50, 150, and 250 C for 3 hours at each temperature, and the types and amounts of the outgassed products were determined. Carbon monoxide, hydrocarbons, aldehydes, nitrogen oxides, and sulfur dioxide were outgassed. Of these, only the amount of carbon monoxide produced by diesel fuel W-375 and the amount of aldehydes produced by the conventional diesel fuel were relatively significant since each exceeded the Threshold Limit Value for these constituents by a factor of about 13. Some decomposition was evidenced when fuel W-375 was heated up to 245 C. It is recommended that similar studies be performed with more types of synthetic fuels as these develop and become available in order to establish a better comparison of outgassing between these fuels and the conventional fuels.
Author (GRA)

N82-11235# Agri Stills of America, Springfield, Ill.
DEVELOPMENT OF A SMALL-SCALE COMMERCIAL ALCOHOL DEHYDRATION 190 TO 200 PROOF Final Report
1981 5 p refs
(Contract DE-FG02-81AF-92005)
(DE81-030158; DOE/AF-92005/T1) Avail: NTIS HC A02/MF A01

A small scale farm sized commercial unit to produce anhydrous 200 proof ethanol from 190 proof source of locally produced grain alcohol (ETOH) was investigated. The approach is to investigate a low pressure process to efficiently separate water from 190 proof alcohol, with and without the use of a third component to break the azeotrope of water and alcohol formed during atmospheric conditions. Results from this experiment show that a vacuum shell is not sufficient in design to effect wet alcohol to the anhydrous state.
DOE

N82-11236# Cincinnati Univ., Ohio. Dept. of Chemistry.
COAL HYDROGENATION VIA BONDING OF METALLIC COMPOUNDS TO COAL, PART 1. SOLUBILIZATION OF ILLINOIS #5 BITUMINOUS COAL - THE CRITICAL IMPORTANCE OF METHYLENE GROUP CLEAVAGE, PART 2 Final Report
Milton Orchin 1981 23 p refs
(Contracts DE-AS01-76ET-10517; EF-76-01-2308-10)
(DE81-027562; DOE/ET-10517/T1) Avail: NTIS HC A02/MF A01

Data for the hydrogenation of Elkhorn coal at 390 C with the initial pressure of 13.8 MPa hydrogen and with various catalysts (stannous chloride and complexes of cobalt and tin), and solvents (decalin and tetralin) are presented in tabular form and results are discussed. Model compounds of coal, polystyrene beads were tin-bonded and tin-impregnated, then hydrogenated under various temperatures, pressures, and with either decalin or tetralin. Results show both hydrogen and the tin catalyst are necessary for liquefaction at 390 C, and under comparable conditions, bonded tin gave greater liquefaction than impregnated tin but with considerably greater hydrogen consumption. In the coal solubilization study, solubilization by hydroliquefaction and by chemical reduction with potassium in tetrahydrofuran seems to indicate that initial degradation of coal by both techniques

proceeds by ether cleavage and that further degradation is achieved in both cases by methylene bridge attack. The nuclear magnetic resonance studies on hydroliquefaction products indicate that Illinois bituminous coal is structurally quiet homogeneous. DOE

N82-11237# Northern Resources, Inc., Billings, Mont.
FEASIBILITY AND ECONOMIC STUDY OF MEDIUM-BTU COAL GAS BLENDED WITH HIGH-BTU BY PRODUCT GAS AS AN INDUSTRIAL ENERGY SOURCE AT BILLINGS, MONTANA
May 1981 23 p
(Contract DE-FG01-79RA-20219)
(DE81-025166; DOE/FE-20219/1) Avail: NTIS HC A02/MF A01

The technical and economic feasibility of blending a medium Btu gas (CMG) produced from coal by the Winkler fluidized bed gasification process with excess refinery fuel gas to be used as an industrial fuel in Billings, Montana is assessed. The background of the project; the site selection process, the conceptual design of the process and supporting facilities, the retrofit requirements and other costs associated with burning the MBG, the environmental and permitting aspects of the project, the cost estimates and economic considerations, the contract provisions for MBG buy/sell agreements, the government's role in supporting the project and the market potential for the project in Billings and similar projects in other markets are discussed. It is concluded that the project is technically feasible and economically viable today although parity with conventional fuels will not occur until 1985. DOE

N82-11238# AmeriGas, Inc., Valley Forge, Pa.
CONCEPTUAL DESIGN FOR A MULTI-USER MEDIUM BTU COAL GASIFICATION COMPLEX. VOLUME 1: EXECUTIVE SUMMARY
Sep. 1980 106 p
(Contract DE-FG01-80RA-50135)
(DE81-027139; DOE/FE-50135/2) Avail: NTIS HC A06/MF A01

On the basis of fuel requirements, a gasifier to produce immediate Btu gas (250 Btu/SCF) at a scale of 8.3 million Btu/day was designed. The basic conclusion, based upon the $6.45/MM Btu required selling price of IFG for this project, was that the facility, as designed, does not present a viable business opportunity. Still existing are the customer's need for long term, stable supplies of clean energy with high fuel utilization load factors. The failure to produce a viable business opportunity does not condemn the process or the project. Even at $6.45/MM Btu, the economic attractiveness of the project was not so poor as originally perceived. When the recent volatile energy price variations are coupled with current rates of inflation and proposed deregulation of natural gas, the long-term attractiveness of IFG is visible. The hurdle here is convincing management that the risks of accepting a higher, yet secure cost of energy now is more than off-set by future savings. Various financial incentives are considered. DOE

N82-11240# New York State Energy Research and Development Authority, New York.
LOW/MEDIUM-BTU COAL-GASIFICATION ASSESSMENT PROGRAM FOR SPECIFIC SITES OF TWO NEW YORK UTILITIES
Dec. 1980 377 p
(Contract DE-FG01-79RA-20223)
(DE81-025518; DOE/RA-20223/T1) Avail: NTIS HC A17/MF A01

The technical and economic aspects of coal gasification to supply low or medium Btu gas to two power plant boilers are investigated. Coals from different regions of the country were investigated in terms of their availability, mode of transportation and delivered cost to each power plant site. The effects of burning low and medium Btu gas in the selected power plant boilers on efficiency, rating and cost of modifications are also examined. Both plants meet the federal, state and local environmental requirements for air quality, wastewater liquid disposal, and ground level disposal of byproduct solids of the synthetic gas alternative result in bus bar cost savings on a yearly basis within a few years of start up because the cost of gas is assumed to escalate at a lower rate than that of fuel oil, approximately 4 to 5%. DOE

N82-11242# Gulf Science and Technology Co., Pittsburgh, Pa. Chemical and Minerals Div.
EFFECTS OF COMPONENTS OF SYNFUELS ON SOOT FORMATION Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981
J. E. Haebig and P. M. Goldberg Aug. 1981 16 p refs
(Contract DE-AC22-80PC-30307)
(DE81-027961; DOE/PC-30307/3; Gulf-827RM073; QTPR-3) Avail: NTIS HC A02/MF A01

The development of an experimental system for the study of the relationships between the rate and amount of soot formation in the combustion of coal derived synfuels and the chemical composition and molecular constituents of those fuels was completed. A burner and pressure vessel were fabricated and assembled along with a flow control panel for seven gas streams. The optical components for laser light scattering were used. Future experimental features were identified. Data on coal liquid properties and composition are discussed. DOE

N82-11243# Minnesota Gas Co., Minneapolis.
PEAT BIOGASIFICATION DEVELOPMENT PROGRAM
Cambridge, Mass. Dynatech R/D Co. 21 Apr. 1981 240 p refs
(Contract DE-AC01-79ET-14696; Dynatech Proj. MGC-2)
(DE81-028299; DOE/ET-14696/T6; Dynatech-2115) Avail: NTIS HC A11/MF A01

The advantage of the biogasification method is it can use the peat in a high moisture state, thereby eliminating the need to provide energy for drying peat. A preliminary investigation (Appendix B) of the peat biogasification process (funded by Minnesota Gas Company) Showed potential technical and economic feasibility of the process, sufficient to carry out the present program. Based on the results of the present program the solubilization, oxidation, and digestion steps have been defined sufficiently to lead to a more reliable process design and preliminary estimate of the fuel gas production costs. This present program was initiated to develop an experimental data base for the solubilization, oxidation, and fermentation reactions, and to use this data base to develop a conceptual preliminary process design and thus enable a preliminary estimation of the economics (capital and operating costs and unit gas costs) for process.DOE

N82-11244# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ADVANCED SYSTEM EXPERIMENTAL FACILITY: SOLID WASTE TO METHANE GAS. BACKGROUND AND PROCESS DESCRIPTION
R. Isaacson and J. Pfeiffer Mar. 1981 15 p refs
(Contract W-31-109-eng-38)
(DE81-030198; ANL/CNSV-22) Avail: NTIS HC A02/MF A01

The Refuse Conversion to Methane Facility in Pompano Beach, Florida, a 100-ton/day experimental plant to convert municipal solid waste (MSW) to methane for fuel was designed to assess the technical merit of anaerobic digestion of the MSW process. Approximately 40 ton/day of volatile solids are fed to the digesters; of this, about 25 ton/day will be converted to gases. For each pound of volatile solids destroyed, 6.6 std. cu ft of methane gas and 6.6 std. cu ft of CO2 will be produced. Thus, the plant will yield approximately 330,000 std. cu ft/day each of methane and CO2. The most important process variables are to be tested allowing judgments to be made on scale up considerations. DOE

N82-11248# Battelle Pacific Northwest Labs., Richland, Wash.
PRODUCTION AND UTILIZATION OF METHANE FROM ANAEROBIC SLUDGE DIGESTION IN U.S. WASTEWATER-TREATMENT PLANTS
Jul. 1981 109 p refs
(Contract DE-AC01-76CS-20300)
(DE81-029958; DOE/CS-20300/3) Avail: NTIS HC A06/MF A01

Three generic onsite uses were selected for energy and cost accounting analysis: heat generation, mechanical energy generation, and electrical energy generation. Of the gas utilization methods analyzed, the most energy efficient and cost effective was found to be the direct production of mechanical energy to drive aerators and pumps. Between 50 and 80 percent of the mechanical energy required for wastewater treatment can be provided by digester gas. In addition, waste heat can be recovered from the engines to aid in heating the digesters and buildings. Total energy costs for the mechanical energy generation scheme averaged around $30/million gallons treated, compared to

$34/million gallons and $45/million gallons for the electrical energy generation and heat generation schemes, respectively.
DOE

N82-11248# California Univ., Livermore. Lawrence Livermore Lab.
CONTROLLED RETRACTING INJECTION POINT (CRIP) SYSTEM: A MODIFIED-STREAM METHOD FOR IN SITU COAL GASIFICATION
R. W. Hill and M. J. Shannon 15 Apr. 1981 10 p refs Presented at the 7th Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 8-11 Sep. 1981
(Contract W-7405-eng-48)
(DE81-026477; UCRL-85852; CONF-810923-2) Avail: NTIS HC A02/MF A01

The principle of moving the injection point (where the combustion-supporting air or oxygen from the surface is fed into the coal seam) to new areas of unburned coal as the burn progresses in coal gasification is investigated. The controlled retracting injection joint or CRIP system is designed to keep the injection point on the bottom of the coal seam and to move it backwards away from the collapse zone into fresh, solid coal. The principle of controlled retraction allows the operator to choose the optimum time and distance to move the injection point, and consequently the burn zone, to get the best possible performance from the gasifier. Although this system will work with coal seams of any thickness, it is particularly well suited to thick coal seams where the cavity grows by coal collapse as well as combustion. Placement of the production channel at the top of the seam, above the injection well ensures isolation from the effects of collapse and reduces the risk of plugging the production well.
DOE

N82-11261# Department of Energy, Morgantown, W. Va. Energy Technology Center.
ATMOSPHERIC FLUIDIZED-BED PROJECTS TECHNOLOGY OVERVIEW
Feb. 1981 66 p refs
(DE81-027143; DOE/METC-SP-108) Avail: NTIS HC A04/MF A01

The methodology by which DOE-funded projects achieved program goals and objectives is examined. The status of the technology is reviewed, and areas where further development or research is required, and projects where this is being addressed are identified. Current program issues include feed systems, heat transfer, recycle, air-distributor grid design, ignition characteristics, output control, particulate emissions, reliability, and fuel flexibility.
DOE

N82-11263# Department of Energy, Morgantown, W. Va. Energy Research Center.
SURFACE COAL GASIFICATION
Oct. 1980 48 p refs
(DE81-030183; DOE/METC-SP-110) Avail: NTIS HC A03/MF A01

The successful commercial application of surface gasification of coal could enable the United States to use from its vast deposits of coal to produce a wide variety of energy products and chemical feedstocks. The technology base is well developed and extremely flexible for converting coal into alternate products suitable for the demands of a broad and heterogeneous market and a wide array of users/owners. To meet the defined program objectives, several pilot plant and process-development operations are being conducted. Four of these operations are described: (1) combustion engineering low-Btu entrained-bed gasifier; (2) bi-gas high-Btu entrained-bed gasifier; (3) ash-agglomerating fluid-bed gasifier; and (4) the short-residence time high-Btu hydrogasifier. Gasification technology-crosscut conclusions and results of technical problems and issues common to the four pilot plants are discussed.
DOE

N82-11264# Department of Energy, Morgantown, W. Va.
ADVANCED-GASIFICATION PROCESSES
Dec. 1980 66 p refs
(DE81-030184; DOE/METC-SP-183) Avail: NTIS HC A04/MF A01

An analysis of the needs for commercial gasification reveals the following principal categories of information gaps that can be filled by programs already in progress or those readily initiated. The gaps are technology base need required for successful commercialization of both currently available and advanced-gasification processes. The needs are defined further in Table 2-1, which shows the current status of the technology data base. The need areas are classified as follows: Coal Preparation/Feeding/Fins Management, Reactor Design/Performance, Gas Cleaning/Cooling, Acid Gas Removal/Gas Shift and Conversion Data Base on State-of-the-Art and Advaced Technologies, Components/Materials/Instrument Development, Health/Environmental/Safety, and General. It is anticipated that solutions to many of the problems associated with the demonstration plants, the alternative fuel plants, and the Synthetic Fuel Corporation endeavors will not be available during the design and construction phases. However, during the operating and optimization phases of most of these projects prior to commercialization, where additional will have provided the additional data base needed to correct deficiencies and/or to advance the state of the art. DOE

N82-11268# Battelle Pacific Northwest Labs., Richland, Wash. Biomass Program Office.
TRANSPORTATION FUELS FROM SYNTHETIC GAS
E. G. Baker and R. Cuello Aug. 1981 25 p refs
(Contract DE-AC06-76RL-01830)
(DE81-029614; PNL-3951) Avail: NTIS HC A02/MF A01

Twenty-five experimental Fischer-Tropsch synthesis runs were made with 14 different catalysts or combinations of catalysts using a Berty reactor system. Two catalysts showed increased selectivity to transportation fuels compared to typical Fischer-Tropsch catalysts. With a catalyst consisting of 5 wt percent ruthenium impregnated on a Y zeolite (run number 24), 63 to 70 wt percent of the hydrocarbon product was in the gasoline boiling range. Using a 0.5 wt percent ruthenium on alumina catalyst (run number 22), 64 to 78 wt percent of the hydrocarbon product was in the diesel fuel boiling range. Not enough sample was produced to determine the octane number of the gasoline from run number 24, but it is probably somewhat better than typical Fischer-Tropsch gasoline (approx. 50) and less than unleaded gasoline (approx. 88). The diesel fuel produced in run number 22 consisted of mostly straight chained paraffins and should be an excellent transportation fuel without further refining. The yield of transportation fuels from biomass via gasification and the Fischer-Tropsch synthesis with the ruthenium catalysts is somewhat less, on a Btu basis, than methanol (via gasification) and wood oil (PERC and LBL processes) yields from biomass.
DOE

N82-11259# Utah Univ., Salt Lake City. Dept. of Mining and Fuels Engineering.
CHEMISTRY AND CATALYSIS OF COAL LIQUEFACTION: CATALYTIC AND THERMAL UPGRADING OF COAL LIQUID AND HYDROGENATION OF CO TO PRODUCE FUELS Quarterly Progress Report, Oct. - Dec. 1979
W. H. Wiser Aug. 1980 73 p refs
(Contract DE-AC01-79ET-14700)
(DOE/ET-14700/1) Avail: NTIS HC A04/MF A01

Studies of the chemistry and catalysis of coal hydrogenation have been initiated with the construction of a flow reactor for extraction of coal and the development of analytical techniques. Work was initiated on the design of a rotor for (13)C nuclear magnetic resonance of solid coal and extracted coal. Studies on momentum, heat and mass transfer in a fluidized bed simulated conditions for coal hydrogenation and were used to investigate effects of particle size and solids loading. The catalytic upgrading of coal-derived liquids is investigated by studies of the catalytic denitrogenation, desulfurization, deoxygenation and cracking of model compounds. Aging of Co-Mo catalysts was found to reduce the number of active sites but not the nature of the sites. A Raney catalyst is being developed for the hydrogenation of carbon monoxide. Temperature programmed desorption was used to study the properties of an iron manganese oxide catalyst previously shown to give high yields of C2-C10 hydrocarbons.
DOE

N82-11260# Utah Univ., Salt Lake City. Dept. of Mining and Fuels Engineering.
CHEMISTRY AND CATALYSIS OF COAL LIQUEFACTION: CATALYTIC AND THERMAL UPGRADING OF COAL LIQUID AND HYDROGENATION OF CO TO PRODUCE FUELS Quarterly Progress Report, Jan. - Mar. 1980
Wendell H. Wiser Aug. 1980 70 p refs
(Contract DE-AC22-70ET-14700)
(DOE/ET-14700/2) Avail: NTIS HC A04/MF A01

Analysis of a group of coal liquids produced by catalytic hydrogenation of Utah coals with $ZnCl_2$ catalyst was begun. Carbon-13 nuclear magnetic resonance and liquid chromatography

techniques will be used to correlate chemical properties with hydrogenation reactivity. Equipment previously used for downflow measurements of heat and momentum transfer in a gas-coal suspension was modified for upflow measurements. The catalytic hydrodeoxygenation of methyl benzoate has been studied to elucidate the reactions of ester during upgrading of coal-derived liquids. The kinetics of hydrogenation of phenanthrene have also been determined. The catalytic cracking mechanism of octahydroanthracene is reported in detail. Studies of the hydrodesulfurization of thiophene indicate that some thiophene is strongly adsorbed as a hydrogen-deficient polymer on cobalt-molybdate catalyst. Part of the polymer can be desorbed as thiophene by hydrogenation. Poisoning of the catalyst inhibits the hydrosulfurization activity to a greater degree than the hydrogenation activity. Iron-manganese catalysts for carbon monoxide hydrogenation is studied to determine the role of iron carbide formation on selectivity. Pure iron catalyst forms a Hagg iron carbide phase unde reaction conditions. DOE

N82-11261# COECORP, Mountain View, Calif.
WORKSHOP PROCEEDINGS: COMBUSTION TURBINE RESIDUAL OIL
May 1981 291 p Workshop held at Atlanta, 17-18 Jul. 1980 Sponsored by EPRI
(EPRI-WS-80-132; CONF-8007109) Avail: NTIS HC A13/MF A01

Technology developed for the reliable and efficient operation of gas turbines using heavy fuel oils or alternative to petroleum distillates is described. Topics covered include combustion system design, turbine gas path design, corrosion resistant materials, turbine deposits, fuel treatment, fuel processing, and additives. Turbine operating conditions and performance are also discussed. A.R.H

N82-11267# California Univ., Livermore. Lawrence Livermore Lab.
LLNL UNDERGROUND COAL GASIFICATION PROJECT Quarterly Progress Report, Jan. - Mar. 1981
D. U. Olness, ed. and Wallace Clements, ed. 27 Apr. 1981 42 p refs
(Contract W-7405-eng-48)
(DE81-030634; UCRL-50026-81-1) Avail: NTIS HC A02/MF A01

Laboratory studies of forward gasification through drilled holes in small blocks of coal, approximately 1 foot on a side were conducted. Such studies give insight into cavity growth mechanisms and particulate production. However, because of the small dimensions involved, the information these tests provide is necessarily limited to aspects of cavity growth at very early times. The preliminary process design of the Tono No. 1 field experiment in Washington was completed. The experimental plan and operational strategy was developed to ensure that the injection point remains near the bottom of the coal seam and that the experiment continues at least until a period of stable operation is reached and sustained for a time. A mathematical model for the small coal block experiments in order to further our understanding of the physical and chemical processes governing the burning of the coal and the growth of the cavity within the block is being developed. Groundwater samples from wells located at distances of a few feet to several hundred feet from the gasification cavities were collected before, during, and after each of the Hoe Creek tests. The analysis of the groundwater contamination data pertinent to the Hoe Creek No. 3 test was completed. DOE

N82-11269# Water Resources Council, Washington, D.C.
COAL LIQUEFACTION DEMONSTRATION PLANT NEAR MORGANTOWN, WEST VIRGINIA; WATER ASSESSMENT REPORT SECTION 13(b) Final Report
Nov. 1980 40 p refs Prepared in cooperation Ohio River Basin Commission
(PB81-216095) Avail: NTIS HC A03/MF A01 CSCL 08H

Water requirements and water supply availability were assessed for a proposed coal liquefaction demonstration project at Fort Martin near Morganown, WV. A policy for consumptive use makeup and the impact on other offstream uses, navigation, and water quality are also examined. GRA

N82-11271# TRW, Inc., McLean, Va. Energy Engineering Div.
GAS RECOVERY FROM COAL DEPOSITS Final Report
A. A. Lee, C. R. Skillern, and D. R. Watkins Jan. 1981 113 p refs
(Contract GRI-5011-321-0101)
(PB81-222291; GRI-80/0033) Avail: NTIS HC A06/MF A01 CSCL 08I

The production potential of coalbeds at depth below 2500 feet was assessed and the effectiveness of hydraulic fracturing in deep coalbeds was determined. Two deep tests were performed, one in the Greater Green River Area and one in the Piceance Basin, both in Colorado. GRA

N82-11397*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
LEWIS RESEARCH CENTER'S COAL-FIRED, PRESSURIZED, FLUIDIZED-BED REACTOR TEST FACILITY
John A. Kobak and R. James Rollbuhler Oct. 1981 35 p refs
(NASA-TM-81616; E-621) Avail: NTIS HC A03/MF A01 CSCL 20D

A 200-kilowatt-thermal, pressurized, fluidized-bed (PFB) reactor, research test facility was designed, constructed, and operated as part of a NASA-funded project to assess and evaluate the effect of PFB hot-gas effluent on aircraft turbine engine materials that might have applications in stationary-power-plant turbogenerators. Some of the techniques and components developed for this PFB system are described. One of the more important items was the development of a two-in-one, gas-solids separator that removed 95+ percent of the solids in 1600 F to 1900 F gases. Another was a coal and sorbent feed and mixing system for injecting the fuel into the pressurized combustor. Also important were the controls and data-acquisition systems that enabled one person to operate the entire facility. The solid, liquid, and gas sub-systems all had problems that were solved over the 2-year operating time of the facility, which culminated in a 400-hour, hot-gas, turbine test. A.R.H.

N82-11404# Denver Research Inst., Colo.
TWO-PHASE FLOW IN GEOTHERMAL ENERGY SOURCES Final Technical Report
Jul. 1981 240 p refs Prepared jointly with Coury and Associates, Lakewood, Colo. and Houston Univ.
(Contract De-AC02-76ET-28359)
(DE81-029037; DOE/ET-28359/T1) Avail: NTIS Hc A11/MF A01

A geothermal well consisting of single and two-phase flow sections was modeled in order to explore the variables important to the process. For this purpose a computer program was developed in a versatile form in order to be able to incorporate a variety of two phase flow void fraction and friction correlations. A parameteric study indicated that the most significant variables controlling the production rate are hydrostatic pressure drop or void fraction in the two-phase mixture and heat transfer from the wellbore to the surrounding earth. Downhole instrumentation was developed and applied in two flowing wells to provide experimental data for the computer program. The wells (East Mesa 8-1, and a private well) behaved differently. Well 8-1 did not flash and numerous shakedown problems in the probe were encountered. The private well did flash and the instrumentation detected the onset of flashing. A Users Manual was developed and presented in a workshop held in conjunction with the Geothermal Resources Council. DOE

N82-11405# Oak Ridge National Lab., Tenn. Energy Div.
CYCLE AND PERFORMANCE ANALYSIS OF ABSORPTION HEAT PUMPS FOR WASTE HEAT UTILIZATION
Horacio Perez-Blanco and Gershon Grossman Sep. 1981 56 p refs
(Contract W-7405-eng-26)
(DE81-030705; ORNL/TM-7852) Avail: NTIS HC A04/MF A01

A heat pump was designed to upgrade low-temperature waste heat by boosting its temperature typically from 600 C (1400 F) to 1200 C (2500 F). The system uses part of the low-temperature heat as its energy source and does not need outside power, except for running small auxiliary equipment. The heat pump employs a desorber/evaporator combination in which some hot water from the heat source is evaporated and the vapor is absorbed in a concentrated absorbent solution. The heat of absorption serves to raise the temperature of the rest of the hot water stream. Two stages of the system are used in series to provide the desired temperature boost. Both are served by one desorber which uses part of the waste heat to concentrate the solution.

Both open- and closed-cycle regeneration of the solution was studied. The operation of the system is described and its performance criteria defined. Results of a computer study show the variation in performance with different design variables. Two working materials, LiBr-water and LiCl-water, are considered. DOE

N82-11474# California Univ., Berkeley. Lawrence Berkeley Lab.
NOVEL DESIGN OF PRESSURE VESSELS AND THERMAL SHIELDS IN COAL GASIFIERS
B. W. Loo Jun. 1981 11 p refs Presented at the Symp. on Instr. and Control for Fossil Energy Processes, San Francisco, 7-10 Jun. 1981
(Contract W-7405-eng-48)
(DE81-025828; LBL-12807) Avail: NTIS HC A02/MF A01

Two outstanding problems in commercial sized coal gasifiers, namely, detecting and locating any deterioration in the refractory thermal barrier and the construction of a safe pressure vessel utilizing advanced carbon fiber composite technology are described. Design considerations are given for a typical gasifier some 30 feet in diameter by 150 feet tall with a maximum internal temperature and pressure of 2500 F and 1500 psi respectively. A system of computer controlled cooling circuits is deployed between the refractory barrier and the external lightweight pressure vessel. Multiple levels of redundancy are built in to guard against any component failure. Through the sensing of coolant temperature and the modulation of coolant flow, a map of heat flux distribution over the gasifier wall may be generated with a spatial resolution of about 5 feet. Results indicate that the coolant temperature rise can be maintained by no more than 90 F with only a modest amount of coolant flow. DOE

N82-11516*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GEOLOGIC CONSIDERATIONS IN UNDERGROUND COAL MINING SYSTEM DESIGN
Frank A. Camilli, David P. Maynard, Arnis Mangolds, and Jack Harris 1 Oct. 1981 52 p refs
(Contracts NAS7-100; DE-AI01-76ET-12548)
(NASA-CR-164961; JPL-Pub-81-74; DOE/ET-12548/9) Avail: NTIS HC A04/MF A01 CSCL 08I

Geologic characteristics of coal resources which may impact new extraction technologies are identified and described to aid system designers and planners in their task of designing advanced coal extraction systems for the central Appalachian region. These geologic conditions are then organized into a matrix identified as the baseline mine concept. A sample region, eastern Kentucy is analyzed using both the developed baseline mine concept and the traditional geologic investigative approach. A.R.H.

N82-11518# Argonne National Lab., Ill. Energy and Environmental Systems Div.
PETROLEUM GEOLOGY AND RESOURCE ASSESSMENT OF THE MIDDLE CASPIAN BASIN, USSR, WITH SPECIAL EMPHASIS ON THE UZEN FIELD
G. Ulmishek and W. Harrison May 1981 157 p refs
(Contract W-31-109-eng-38)
(DE81-029951; ANL/ES-116) Avail: NTIS HC A08/MF A01

The Middle Caspian Basin contains up to 12,000 m (40,000 ft) of sedimentary rocks ranging in age from late Paleozoic to Quaternary and has over 100 oil and gas fields varying in size from small to supergiant. The Soviet literature reviewed covers: (1) tectonic zones of the basin, including details of the lower, intermediate, and upper structural complexes; (2) paleogeography, facies distribution, and conditions of organic matter accumulation in the major petroleum source rocks; (3) stages of oil and gas generation; (4) major hydrogeological features; and (5) producing regions of the basin. Total initial petroleum resources of the basin are estimated at 22.5 x 10(9) t (166 x 10(9) bbl), of which 16.00 x 10(9) t (118 x 10 (9) bbl) are yet to be discovered. Resources of the Offshore Caspian Sea area are estimated to be 12.1, 10(9) t (89.5 x 10(8) bbl). DOE

N82-11519# Rhode Island Univ., Kingston.
PLANNING A COMPREHENSIVE PROGRAM FOR EXPLORATION OF THE ANTHRACITE DEPOSITS OF THE NARRAGANSETT BASIN OF MASSACHUSETTS AND RHODE ISLAND, PHASE 1 AND 2 Final Report
J. W. Skehan Feb. 1981 131 p refs
(Contract DE-AC01-79RA-2036)
(DE81-028490; DOE/FE-20036/1) Avail: NTIS HC A07/MF A01

Coal deposits occur in a sporadic fashion throughout the Basin with little continuity as to the type of deposit and the quality of coal thus making it difficult, perhaps very expensive and risky, to base a drilling program soley on stepping out from known outcrops and coal occurrences. The combination of understanding the original depositional environment, its subsequent deformation to stepping out from known coal occurrences, is believed to be the most efficient basis for developing a comprehensive drilling program plan for the Basin. This limited exploration program produced resource estimates of 11.35 million tons of anthracite material in the eastern and 4.73 in the western part of Portsmouth, Rhode islands, area and 4.2 million tons in Plainville, Machusetts. These estimates are based on USGS recommended methods for resource determination. The cost of finding this material, based on the cost of the contracts, comes out to be approximately 1.5 cents per ton. DOE

N82-11520# Royal Norwegian Council for Scientific and Industrial Research, Oslo.
PLAN FOR TECHNOLOGICAL RESEARCH AND DEVELOPMENT RELATED TO THE PETROLEUM ACTIVITIES ON THE NORWEGIAN CONTINENTAL SHELF, 1981-1985: APPENDIXES: 1. TECHNICAL CHALLENGES. 2. RESEARCH REQUIREMENTS. 3. HIGH PRIORITY PROGRAMS
10 May 1980 171 p
(DE81-904014; NP-1904014) Avail: NTIS HC A08/MF A01

The environmental and geographical conditions on the Norwegian Continental Shelf (NCS) which may effect field exploration and development philosophy or the choice of technological solutions are identified. Research requirements are described in the areas of physical environment; petroleum exploration; petroleum technology; production technology; sub-sea production systems; platforms and supporting equipment; storage and offshore loading; pipelines; underwater support functons; above-water support functions; automation in offshore production and transportation; communications and positioning; materials and corrosion protection; quality assurance; and regulations. High priority programs were defined based on the general objectives of the national petroleum policy, resource management, safety, industrial development, and cost reduction. DOE

N82-11523# Boston Coll., Weston, Mass. Dept. of Geology and Geophysics.
EXPLORATION OF COAL AND ANTHRACITIC CARBONACEOUS SHALE RESOURCES, NARRAGANSETT BASIN, MASSACHUSETTS, AND RHODE ISLAND Final Report, 1 Oct. 1979 - 30 Arp. 1981
James W. Skehan, Greta E. Gill, Jonathan D. Raben, Norman Schapiro, and Daniel P. Murray May 1981 86 p refs
(Contract DE-AC01-79RA-20029)
(DE81-030895; DOE/RA-20029/T1) Avail: NTIS HC A05/MF A01

Results of continuous core drilling primarily in two contiguous fields to evaluate the carbonaceous resource are presented. Geological and analytical results, resource calculations, and evaluations of potential mining methods and conditions are included. Results of fieldwork and drilling in the Portsmouth, Rhode Island area defined the coal-bearing structure as being a southerly plunging fold, with the western limb and the eastern holes penetrating the axial portion of the fold. In the Plainville, Massachusetts area, an E-W trending anticline was defined by fieldwork and exploratory drilling. The anthracitic carbonaceous shale seam folded by this structure varies in thickness and ash content along strike. T.M.

N82-11571# Aerojet Energy Conservation Co., Sacramento, Calif.
FLUID-BED HEAT-EXCHANGER OPTIMIZATION AND BED MATERIALS SELECTION Final Report
Feb. 1981 127 p refs
(Contracts DE-AC22-78ET-11343; DE-AC03-79ET-11343; ET-78-C-03-2039)
(DOE/ET-11343/T2; Rept-8100-FB-0003) Avail: NTIS HC A07/MF A01

The effect of material properties on heat exchanger costs for waste gas streams from 500 to 3000OF was evaluated. The cost of the major heat exchanger components was identified and related directly to bed material properties. Two hundred materials were reviewed: metals, alloys, oxides, minerals,

carbides, borides, intermetallics, and cermets. It is shown that the oxides and minerals were the most cost effective at the lower bed temperatures and the metallic bed materials at the higher bed temperature. DOE

N82-11673# Argonne National Lab., Ill. Energy and Environmental Systems Div.
PRELIMINARY EVALUATION OF ADVANCED COAL-BASED ELECTRICITY-GENERATING TECHNOLOGIES BY MEANS OF SYSTEM-INTEGRATION ANALYSIS
J. L. Gillette and K. Hub Apr. 1981 41 p refs
(Contract W-31-109-eng-38)
(DE81-029989; ANL/EES-TM-144) Avail: NTIS HC A03/MF A01

The potential effects of coal fired cogeneration on production requirements were examined. Two types of cogeneration designs, a backpressure turbine and an extraction turbine were studied. It is found that some savings of oil can be realized with coal based cogeneration, and that the quantity of such is dependent on the purchase option, the demand growth rate, and the cogenerator design. It is concluded that of the two designs the backpressure turbine type has an advantage due to its significantly lower heat rate. DOE

N82-11688# Princeton Univ., N. J.
IS GEOTHERMAL SIMULATION A CATASTROPHE?
V. V. Nguyen and George F. Pinder 1980 5 p refs Presented at 6th Ann. Workshop on Geothermal Reservoir Engr., Stanford, Calif., 16-18 Dec. 1980
(DE81-026750; CONF-801233-10) Avail: NTIS HC A02/MF A01

All numerical simulators of geothermal reservoirs depend upon an accurate representation of the thermodynamics of steam-water systems. These relationships are required to render tractable the system of balance equations derived from the physics of flow through porous media. While it is generally recognized that steam-water system (i.e., two phase) is not thermodynamic equilibrium, equilibrium thermodynamics are employed in its description. An alternative view based on non-equilibrium thermodynamics is presented. The underpinnings of this approach are found in a branch of topology generally referred to as catastrophe theory. DOE

N82-11811# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
OCEAN ENERGY-WAVES, CURRENTS, AND TIDES
J. Miles and B. Shelpuk May 1981 11 p refs Presented at Energy in the Man-Built Environ. Urban Planning and Develop. Div. Spec. Conf., Vail, Colo., 3-5 Aug. 1981
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-025708; SERI/TP-634-1195; CONF-81080808) Avail: NTIS HC A02/MF A01

An overview is presented on the mechanical forms of ocean energy; i.e., waves, currents, and tides. Following an introductory section on wave mechanics, each of the three forms of ocean energy is considered under the headings of the resource, device types for energy extraction, and prognosis for practical implementation. DOE

N82-11883 Colorado Univ. at Boulder.
GEOLOGY OF THE NAHCOLITE DEPOSITS AND ASSOCIATED OIL SHALES OF THE GREEN RIVER FORMATION IN THE PICEANCE CREEK BASIN, COLORADO Ph.D. Thesis
John Richard Dyni 1981 182 p
Avail: Univ. Microfilms Order No. 8122279

Stratigraphic and lithologic studies of drill cores from 10 exploratory holes reveal that five eights of the nahcolite resource, occurs as crystalline aggregates in maristone. The remainder of the resource consists of laterally continuous zones of disseminated nahcolite in maristone and beds of mixed nahcolite and halite. Sedimentologic data indicate that the maristones and associated sodium minerals were deposited by pelagic, turbiditic, and evaporitic processes in a permanent alkaline lake. Lower lake waters and sediments favored high rates of bacterial reduction of sulfate and hydrolysis of fine grained detrital silicate minerals. These processes resulted in production of bicarbonate and the formation of an authigenic suite of carbonate and silicate minerals devoid of clay and sulfate minerals. Cyclic probably seasonal, stratification is recorded by the laminated maristones and in some units of disseminated and bedded nahcolite and halite. The vertical distribution of total sulfur in the maristones is also cyclic and may be related to evaporative phases of the lake. Dissert. Abstr

N82-11715# Los Alamos Scientific Lab., N. Mex.
RELAXATION OF GEOTHERMAL-RESERVOIR STRESSES INDUCED BY HEAT PRODUCTION
H. Murphy, ed., R. Aamodt, H. Fisher, T. Grant, C. Grigsby, R. Hendron, H. Keppler, C. Pearson, R. Potter, and G. Suhr Aug. 1981 34 p refs
(Contract W-7405-eng-36)
(DE81-032024; LA-8954-MS) Avail: NTIS HC A03/MF A01

Fifteen million kWh of thermal energy were produced during 281 days of operation of the hot dry rock (HDR) geothermal reservoir at Fenton Hill, New Mexico. Following this heat production the thermal stresses and strains so were partially released by a shot, 7-h pressurization of the reservoir above the local tectonic confining stress. Following the partial stress release, it was found that the resistance to water flow through the reservoir was decreased by 37 percent, and that the reservoir volume, as measured by tracer studies, increased by 43 percent. Microseismic events recorded with geophones in two deep wells at positions within a few hundred meters of the reservoir were concentrated in those regions of the reservoir most affected by thermal depletion. These events define a reservoir region and size in qualitative agreement with estimates based upon heat production modeling. DOE

N82-12166 Arizona Univ., Tucson.
FUEL NITROGEN CONVERSION DURING FUEL RICH COMBUSTION OF PULVERIZED COAL AND CHAR Ph.D. Thesis
James William Glass 1981 334 p
Avail: Univ. Microfilms Order No. 8121921

The conversion of coal and char nitrogen is investigated during fuel rich combustion. The roles of NO, HCN, and NH3, and char nitrogen in the post combustion gases in the first, fuel rich stage of a staged combustor are clarified. The fuel rich conversion of char nitrogen show that at all stoichiometries, the concentrations of HCN and NH3 in the post time gases are small compared to the concentration of NO. Char nitrogen conversion is stoichiometric or greater. Destruction of NO is found to be controlled by a heterogeneous mechanism involving the char carbon surface. The mechanism is deactivated by oxygen. Dissert. Abstr.

N82-12182# Georgetown Univ., Washington, D.C.
INDUSTRIAL APPLICATION OF FLUIDIZED-BED COMBUSTION Quarterly Technical Progress Report, Jan. - Mar 1981
1981 123 p
(Contract DE-AC21-76ET-10381)
(DE81-030272; DOE/ET-10381/197) Avail: NTIS HC A06/MF A01

An atmospheric fluidized bed boiler using high sulfur coal functioning as a source of steam was constructed and is operated as a demonstration plant. Operations since start up are summarized. Boiler thermal efficiency is low. Factors affecting efficiency are discussed. S.L.

N82-12187# Energy and Environmental Research Corp., Santa Ana, Calif.
ASSESSMENT OF PULVERIZED-COAL-FIRED COMBUSTOR PERFORMANCE Quarterly Progress Report, 1 Apr. - 30 Jun. 1981
W. Richter, W. Clark, and R. Payne Jul. 1981 28 p refs
(Contract DE-AC22-80PC-30297)
(DE81-030860; DOE/PC-30297/T4; QPR-3) Avail: NTIS HC A03/MF A01

This program is concerned with the provision of a technology base to expedite the conversion of industrial processes from oil and gas to coal and other pulverized fuels. It addresses primarily the impact of fuel type on the thermal performance of a combustor. The program incorporates two experimental tasks and is constructed around an analytical task (Task 1) which will identify and upgrade a family of computer programs required to undertake thermal performance analysis studies. These anaytical tools will thus be used to predict the effects of parameters such as fuel type and furnace variables on combustor performance, and to identify those properties which have a major impact on thermal performance. The second task uses a combustion reactor to screen the key variable identified in Task I and to provide

data on the properties of coal particulate matter which affect heat transfer performance. Verification of the engineering analytical approach will be provided by measurements made in a pilot-scale furnace in the third task. Progress is reported. DOE

N82-12194# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.
COAL COMBUSTION IN HIGH CONVECTIVE FLOWS Progress Report, 1 Mar. - 31 Aug. 1981
Kenneth W. Ragland 8 Sep. 1981 6 p
(Contract DE-FG22-80PC-30213)
(DE81-030391; DOE/PC-30213/T1) Avail: NTIS HC A02/MF A01

Fundamental data on ignition delay, volatile burn time, volatile reactivity, char burn time, char reactivity, aerodynamic drag, particle surface temperature, and internal porosity of burning coal particle are being obtained as a function of coal type, particle size, gas temperature, gas velocity and oxygen concentration. Simulation of conditions inside a furnace has been achieved in two test rigs which have been constructed. In the first rig single coal particle 3 to 12 mm diameter are suspended on a 0.02 mm diameter stainless steel wire which extends from an electronic balance into a 5 mm diameter tube containing flowing electrically heated gas. This setup extends the traditional thermogravimetric analysis to flowing systems. In the second rig coal particles are levitated freely in a 50 mm diameter diverging insulated quartz nozzle. To date 16 fixed particle test runs have been made-7 with a Kentucky bituminous coal, 3 with a Montana sub-bituminous and 6 with a Texas lignite. Gas temperture ranged from 760 to 11400K, flow rates 2 to 11 scfm, gas-particle velocities from 1.8 to 10.4 m/s, and Reynolds numbers from 100 to 1150. DOE

N82-12196# Cornell Univ., Ithaca, N. Y.
PYROLYSIS OF COAL-DRIVED FUELS USING THE LASER-POWERED HOMOGENEOUS PYROLYSIS TECHNIQUE Technical Progress Report, 5 Aug. 1980 - 31 Jul. 1981
P. C. T. deBoer 31 Jul. 1981 19 p refs
(Contract DE-FG22-80PC-30217)
(DE82-000251; DOE/PC-30217/T2) Avail: NTIS HC A02/MF A01

The progress made can be divided into two areas: theoretical work leading to an accurate computation of the temperature and velocity fields in the sample cell; and experimental work studying various chemical reactions involving hydrocarbons. The laser-powered homogeneous pyrolysis (LPHP) technique was applied to the unimolecular decomposition of 1,4-cyclohexandiene to benzene and hydrogen and of 1-chloropropane (n-propylchloride) to propene and hydrogen chloride as well as to the isomerization of cis-2-butene to trans-2-butent. These reactions proceed in different temperature ranges, with reaction rates that are well known. The temperature range covered is 575 to 8500K. The objective of this investigation was to establish proper operation of the LHLP technique over the temperature range of interest for the pyrolysis of coal-derived hydrocarbons. A set of equations was derived describing the motion of the strongly heated gas in the sample cell. The equations take account of the variations of viscosity and thermal conductivity with temperature, as well as of the dependence of the radiation absorption coefficient on temperature and density. DOE

N82-12197# Pittsburg and Midway Coal Mining Co., Englewood, Colo
SOLVENT-REFINED COAL (SRC) PROCESS Final Report
Aug. 1981 87 p refs
(Contract DE-AC05-76ET-10104)
(DE81-031937; DOE/ET-10104/12) Avail: NTIS HC A05/MF A01

In late 1979 the Pittsburgh and Midway Coal Mining Co., recommended to the Department of Energy that certain areas of the SRC Pilot Plant should be modified to represent the SRC-II Demonstration Plant design. The proposed modifications were for design confirmation; start-up, transient and other operational guidance studies; and training of operator and professional personnel. The pilot plant facilities proposed for modification were: Coal Slurry Mixing - Area 01; Dissolver Effluent Cooling and Separation - Area 02; and Vacuum Flash/Residue Pump Testing - Area 04. A summary justification assessment for the modifications is included. A preliminary engineering study by Badger Energy, Inc. was completed in late 1980. A proposed to begin detailed engineering had been submitted to DOE for approval when all work was discontinued at the direction of the DOE in April 1981. DOE

N82-12198# Montana State Univ., Missoula.
CATALYTIC HYDROGENATION OF COAL-DERIVED LIQUIDS Interim Report, Mar. - May 1981
Lloyd Berg and F. P. McCandless Jul. 1981 50 p
(Contracts EX-76-C-01-2034; DE-AC22-76ET-10495)
(DE81-030485; DOE/ET-10495/T2; FE-2034-23) Avail: NTIS HC A03/MF A01

Two runs of more than 100 hours of catalyst life were completed using SRC-I and SRC-II as the feeds. One run had catalyst regeneration every three hours, the other every eight hours. The catalyst, 4% CoO, 8% MoO3, 1% NiO and 8% WO3 on NALCO-78-6008C alumina base, reduced the nitrogen content to less than 0.3% showed no signs of deterioration in activity. Regeneration after the three or eight hour periods was by burnoff with oxygen in nitrogen followed by re-sulfiding with H2S in hydrogen. The liquid yield from SRC was 90% of which 30% was 50 to 2040C boiling range gasoline. It appears that a viable process to convert SRC into a feedstock acceptable to a petroleum refinery was discovered. A study of the effect of carbon laydown on pore volume and subsequent deactivation of the catalyst was carried out in a pressurized batch reactor. Little reduction in pore volume was noted. Three commerical catalysts, Harshaw HT400, NALCO MO477 and NALCO MN502, were evaluated with SRC-II. DOE

N82-12199# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
OXYDESULFURIZATION OF COAL BY ACIDIC IRON SULFATE SOLUTIONS M.S. Thesis
David A. Mixon and Theodore Vermeulen Aug. 1981 161 p refs
(Contract W-7405-eng-48)
(DE82-000464; LBL-9963-Rev) Avail: NTIS HC A08/MF A01

To facilitate by-product recovery and eliminate elemental sulfur formation in coal oxydesulfuirization, high-sulfur bituminous coal has been treated with aqueous ferric sulfate/sulfuric acid and oxygen at 100 to 1500C. The rate of pyrite oxidation increases with oxygen partial pressure, temperature, and fitness of grinding. This reaction rate is relatively insensitive to sulfuric acid and ferric sulfate concentrations, so that pyrite removal may be satisfactorily performed in solutions containing 25% H2SO4 and 12% Fe2(SO4)3 (weight percentages relative to total H2O plus HsSO4); preliminary data suggest that such a leaching solution is only mildly corrosive to T316 stainless steel, at 1500C or below, in the presence of oxygen. To provide an accurate assessment of coal oxydesulfurization stoichiometry, and analytical technique based on uv spectrophotometry has been developed for the determination of elemental sulfur in coal. Prepared coal samples are extracted for 24 hours with cyclohexane. Other exploratory oxydesulfurization runs have shown that vanadium oxides are not effective catalysts at 1000C, with oxygen. DOE

N82-12200# Utah Univ., Salt Lake City. College of Mines and Mineral Industries.
INVESTIGATION OF FACTORS AFFECTING THE IN-SITU COMBUSTION RETORTING OF OIL SHALE Final Report
H. Y. Sohn, C. H. Pitt, and A. G. Oblad 29 May 1981 168 p refs
(Contracts DE-AS03-78ET-13095; ET-77-S-03-1760; EF-77-S-04-3909)
(DE82-000482; DOE/ET-13095/T1) Avail: NTIS HC A08/MF A01

Subprocess taking place during an in situ combustion retorting of oil shale were investigated. Some of these subprocesses also occur in a surface retorting process. The specific topics of this research program include: (1) experimental determination of the intrinsic kinetics of kerogen decomposition producing oil; (2) mathematical formulation of the retorting of a oil shale block in the presence of heat transfer effects; (3) experimental determination of the intrinsic kinetics of oil shale char oxidation; (4) mathematical modeling of the oxidation of oil shale char in a spent shale block in the presence of heat and mass transfer effects; (5) determination of ignition delay and energy requirements for the ignition of an oil shale bed; (6) determination of thermal expansion of oil shale; and (7) determination of heat capacities of oil shale and the heat of decomposition of kerogen. The results of the investigation of these topics are presented. Some

of the results have been published in journals which are readily available. In such a case only a brief summary of the results are presented. DOE

N82-12236 Dartmouth Coll., Hanover, N.H.
PARTIAL ACID HYDROLYSIS PRETREATMENT FOR ENZYMATIC HYDROLYSIS OF CELLULOSE: A PROCESS DEVELOPMENT STUDY OF ETHANOL PRODUCTION Ph.D. Thesis
Diane Ruth Knappert 1981 175 p
Avail: Univ. Microfilms Order No. 8121523

Cellulosic substrates (poplar, corn stover and bagasse) were pretreated in a continuous, plug flow reactor at conditions of 160-220 C, 0-1.5% acid, and retention times up to 13 seconds. The pretreated material was then hydrolyzed with Trichoderma reesei C30 cellulase, for 48 hours. Glucose concentrations were measured during the 48 hours of hydrolysis, and results are compared to those from controls, hydrolysis of untreated material. Results show a significant increase in glucose yields after pretreatment. For example, after pretreatment, glucose yields from hydrolysis of poplar as high as 75% are obtained, compared to 20% yields from hydrolysis of untreated poplar. Successful pretreatments are found to solubilize about 40% of the poplar hemicellulose. The cost of producing ethanol using a 10 MM gal/yr plant size are evaluated, and the process is scaled up to a 50 MM gal/yr plant. Dissert. Abstr.

N82-12238 Houston Univ., Tex.
SOLID-SOLID REACTIONS IN COAL CONVERSION PROCESSES Ph.D. Thesis
Daniel Clark Baker 1981 198 p
Avail: Univ. Microfilms Order No. 8120902

The thermal stability of calcium sulfate and sulfated coal ashes was studied as well as the catalytic effect of metal carbonates on coal char gasfication. Five model reactions which could result in undesirable evolution of sulfur oxides are considered: decomposition of pure CaSO4 between 950 C - 1130 C; decomposition of CaSO4 in the presence of thin film melts of KCl and NaCl at 1020 C; reactions of CaSO4 with metal oxides in binary systems at 1020 C; reactions of CaSO4 with aluminosilicates in multicomponent systems at 1020 C; and decomposition of sulfated coal and lignite ashes at 820 C and 1020 C. Metal carbonates did not change the mechanism of char gasification when CO2 was the reactive gas. It was noted that reactions of the solid-solid complex with silicates and aluminosilicates in the ash of the char can result in loss of catalytic activity and poor catalyst recovery. Dissert. Abstr.

N82-12240*# National Aeronautics and Space Administration. Pasadena Office, Calif.
HYDRODESULFURIZATION OF CHLORINATED COAL Patent Application
John J. Kalvinskas (JPL, California Inst. of Technology, Pasadena) and Naresh K. Rohatgi, inventors (to NASA) (JPL, California Inst. of Technology, Pasadena) Filed 30 Oct. 1981 24 p
(Contract NAS7-100)
(NASA-Case-NPO-15304-1; US-Patent-Appl-SN-315587) Avail: NTIS HC A02/MF A01 CSCL 21D

A method of desulfurization is described in which high sulfur coals are desulfurized by low temperature chlorinolysis of coal in liquid media, preferably water, followed by hydrodesulfurization at a temperature above 500 C. The coals are desulfurized to an extent of up to 90% by weight and simultaneously dechlorinated to a chlorine content below 0.1% by weight. The product coals have lower volatile loss, lower oxygen and nitrogen content and higher fixed carbon than raw coals treated with hydrogen under the same conditions. Heating the chlorinated coal to a temperature above 500 C in inert gas such as nitrogen results in significantly less desulfurization. NASA

N82-12241*# National Aeronautics and Space Administration. Pasadena Office, Calif.
SUPERCRITICAL MULTICOMPONENT SOLVENT COAL EXTRACTION Patent Application
William H. Corcoran, inventor (to NASA) (JPL, California Inst. of Technology, Pasadena) Filed 30 Oct. 1981 27 p
(Contract NAS7-100)
(NASA-Case-NPO-15787-1; US-Patent-Appl-SN-315584) Avail: NTIS HC A03/MF A01 CSCL 21D

The yield of organic extract from the supercritical extraction of coal with larger diameter organic solvents such as toluene is increased by use of a minor amount of from 0.1 to 10% by weight of a second solvent such as methanol having a molecular diameter significantly smaller than the average pore diameter of the coal. NASA

N82-12242# General Accounting Office, Washington, D. C.
STATUS OF THE GREAT PLAINS COAL GASIFICATION PLANT
16 Mar. 1981 30 p
(EMD-81-64) Avail: NTIS HC A03/MF A01

A coal gasification plant with a production capacity of 125 million cubic feet per day of high Btu gas, equivalent to about 22,000 barrels of oil per day, is proposed for Mercer County, N. Dak. This synthetic gas is a direct substitute for natural gas. The process employed to convert the coal to gas is the Lurgi pressurized, fixed bed gasification process with Lurgi methanation. S.L.

N82-12250# Aerospace Corp., El Segundo, Calif. Mobile Systems Directorate.
PROJECT FOR RELIABILITY FLEET TESTING OF ALCOHOL/GASOLINE BLENDS Technical Progress Report
Jul. 1981 85 p refs
(DE82-000004; DOE/CS-50023/T15) Avail: NTIS HC A05/MF A01

Progress is reported in reaching the near-term goal of bringing the end-use technology for formulated alcohol/gasoline blends to the point of commercial technical readiness, in support of the Alcohol Fuels Program element of the DOE Alternative Fuels Utilization Program (AFUP). Activities considered include acquiring data for proof-of-concept through engineering tests in a small controlled fleet using various formulated blends of ethanol/gasoline and methanol/gasoline as well as for statistical proof-of-performance through large-scale reliability fleet tests using selected blends. Implementation of the 4-year plan is continuing in accordance with funding availability. DOE

N82-12251# United Technologies Corp., South Windsor, Conn. Power Systems Div.
EVALUATION OF SHALE OIL AS A UTILITY GAS-TURBINE FUEL Final Report
A. P. Grasso, R. A. Sederquist, F. G. Sykes, J. Frese, J. McVey, G. Lewis (Pratt and Whitney Aircraft, West Palm Beach, Florida), and J. Mathason (Pratt and Whitney Aircraft, West Palm Beach, Florida) Aug. 1981 139 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1691-2)
(DE81-904234; EPRI-AP-1975) Avail: NTIS HC A07/MF A01

An FT4A-9 engine and a selected single-can combustor from an O engine were tested using No. 2 petroleum distillate fuel and hydrotreated Paraho shale oil residual, with and without water injection. The engine operated successfully with low smoke when running on shale oil residual and No. 2 petroleum distillate fuel. The use of hot water injection was successfully demonstrated with reduced No/sub x/ emissions when operating on both fuels. Post-test engine inspection showed that all combustor components, including turbine inlet vanes, were in good condition. No/sub x/ emissions from single-can combustor testing with both fuels exceeding engine levels. Carbon monoxide and unburned hydrocarbons were slightly lower. DOE

N82-12254# Boeing Engineering and Construction, Seattle, Wash. Engineering and Construction Div.
FEASIBILITY AND ECONOMIC STUDY OF MEDIUM-Btu COAL GAS BLENDED WITH HIGH-Btu BY-PRODUCT GAS AS AN INDUSTRIAL ENERGY SOURCE AT BILLINGS, MONTANA Final Report
May 1981 297 p refs Prepared in cooperation with Northern Resources, Inc., Billings, Mont.
(Contract DE-FG01-79RA-20219)
(DE81-030622; DOE/FE-20219/2) Avail: NTIS HC A13/MF A01

The technical and economic feasibility of blending a medium Btu gas (MBG) produced from coal by the Winkler fluidized bed gasification process with excess refinery fuel gas to be used as an industrial fuel in Billings, Montana is assessed. The background of the project, the site selection process, the conceptual design of the process and supporting facilities, the retrofit requirements and other costs associated with burning the MBG, the environmental and permitting aspects of the project, the cost estimates

and economic considerations, the contract provisions for MBG buy/sell agreements; the government's role in supporting the project, and the market potential for the project in Billings and similar projects in other markets are discussed. The project is technically feasible and economically viable today although parity with conventional fuels will not occur until 1985. DOE

N82-12256# Brookhaven National Lab., Upton, N. Y. Catalyst Group.
DEVELOPMENT OF CATALYTIC SYSTEMS FOR THE CONVERSION OF SYNGAS TO JET FUEL AND DIESEL FUEL AND HIGHER ALCOHOLS Annual Report
William A. Slegeir Oct. 1980 18 p
(Contract DE-AC02-76CH-00016)
(DE82-000067; BNL-51423) Avail: NTIS HC A02/MF A01

A highly active series of Fischer-Tropsch catalysts are developed on the basis of insights provided by the oxide theory. The method of catalyst formulation is unique in Fischer-Tropsch chemistry, yet is simple and reproducible. These catalysts are superior to ordinary catalysts for hydrocarbon synthesis with regard to rate, operating conditions, and, product selectivity and longevity. The products of these catalysts are ideally suited for use as diesel and jet fuels. Once formed, the catalysts display remarkable stability toward air. Oxide interactions, the role of promoters, and the synergistic behavior of bimetallic catalysts systems are studied. Bimetallic systems for hydrocarbon and alcohol synthesis are discussed. DOE

N82-12259# Pittsburg Energy Technology Center, Pa.
SYNTHESIS GAS CONVERSION TO LIQUID FUELS USING PROMOTED FUSED IRON CATALYSTS
Richard A. Diffenbach, Richard R. Schehl, and Daniel J. Fauth Sep. 1981 67 p refs
(DE81-030857; DOE/PETC/TR-81/3) Avail: NTIS HC A04/MF A01

More active and stable nitrided iron catalysts were prepared for the conversion of synthesis gas to a proudct with a high alcohol content that could be used directly as an automotive fuel or converted to a gasoline-like product over a shape selective zeolite in a dual reactor unit. The rational is given for the preparation of a molybdenum-promoted nitrided fused ion catalyst. Catalyst characterization yielded equivocal results as to whether a mixed Fe-Mo nitride was formed. Regardless of the nature of the Mo-containing species, these catalysts were significantly more active than unpromoted nitrided fused iron catalyst. Characterization of fused iron catalysts using thermogravimetric analysis indicated the rates of reduction, carburization, and nitriding were strongly dependent on reaction temperature and particle size as well as the nature of the promoter. X-ray diffraction measurements indicated the metal crystallite size of the reduced catalysts was strongly dependent on reduction temperature. DOE

N82-12260# Institute of Gas Technology, Chicago, Ill.
DEVELOPMENT OF HYDROCONVERSION OF BIOMASS TO SYNTHETIC FUELS Technical Progress Report, 1 Jan. - 31 Mar. 1981
Jul. 1981 56 p refs
(Contract DE-AC02-80CS-83004)
(DE81-030954; DOE/CS-83004/3) Avail: NTIS HC A04/MF A01

The physical and chemical characterization data for Douglas fir hog fuel, maple hardwood, and corn stover are presented for comparison. Fluidization parameters were obtained for mixtures of char and hollow alumina spheres (-25 + 60 mesh) as the inert bed material. The driving characteristics of maple hardwood were measured isothermally in the range of 2000 to 4000 F. Three distinct moisture content regions were observed with different characteristic drying behaviors. Size reduction characteristics show that the throughput rate for various product screen sizes is lower for the moist, as-received feed than for the dried feed material. The hydrodevolatilization data of maple hardwood from the rapid heat-up rate, free-fall apparatus were analyzed. Comparison of the steam-char gasification rates of coal, peat, and maple hardwood chars shows that the reactivity level expected of the biomass char is significantly higher than that of coal and peat. DOE

N82-12261# Department of Energy, Morgantown, W. Va.
FIXED-BED GASIFICATION
Jan. 1981 29 p refs
(DE82-000432; DOE/METC/SP-184) Avail: NTIS HC A03/MF A01

Since the completion of construction in 1967, the METC Gasifier Pilot Plant has produced data and demonstrated operation on all major ranks of US coals. In 1976, METC began an expansion program to include a novel gas-cleanup facility to evaluate the environmental problems associated with gasification plants and also to develop improved cleanup systems. The construction and checkout of this full-scale cleanup system was completed within the past year and the pilot-plant facility now has the capability of gasifying all US coals and producing a relatively tar, oil, particulate, and sulfur free fuel gas. The Department of Energy's (DOE) fixed-bed gasification evelopment program includes other facilities that provide DOE with a broad capability to address alternative and advanced gasification technologies. In addition to utilizing these facilities to evaluate and improve gasification/cleanup configurations, the pilot plants are also being used to support a number of related projects. DOE

N82-12262# Argonne National Lab., Ill.
DENSITY-MEASUREMENT STUDIES AT THE BI-GAS PILOT PLANT
S. H. Sheen and A. C. Raptis Sep. 1981 17 p refs
(Contract W-31-109-eng-38)
(DE82-000910; ANL/FE-81-57) Avail: NTIS HC A02/MF A01

An acoustic flow/no-flow monitor for the char return line of the BI-GAS pilot plant was developed. The indicator has operated successfully for the last three years. It was observed that the strength of the microphone signal is related to the amount of char in the line. In a recent experiment at BI-GAS this observation was further explored, and it was found that the signal is related to the char valve opening in the frequency range of 1 to 20 kHz. This is a clear indication that the flow/no-flow indicator can be upgraded to a density meter and consequently to a true mass flowmeter. This can be done by installing another flow/no-flow indicator upstream or downstream of the existing one and cross-correlating the two signals. DOE

N82-12263# Oak Ridge National Lab., Tenn.
SELECTIVE SEPARATION OF COAL FEEDSTOCKS FOR CONVERSION BY MAGNETIC SEPARATION TECHNIQUES
E. C. Hise and A. S. Holman 1981 8 p refs Presented at 91st Natl. Meeting of the Am. Inst. of Chem. Engr., Detroit 16 Aug. 1981
(Contract W-7405-eng-26)
(DE81-028060; CONF-810814-6) Avail: NTIS HC A02/MF A01

The Open-Gradient Magnetic Separation (OGMS) technique can separate particles on the basis of small differences in magnetic susceptibility. The highly reactive coal macerals are diamagnetic while the minerals and less reactive macerals range from slightly diamagnetic to paramagnetic with the pyritic minerals exhibiting the greatest positive magnetic susceptibility. OGMS can spread a falling stream of fine coal into a spectrum permitting the physical separation of these several maceral and mineral groups. Several eastern bituminous coals were selectively separated into five to ten fractions. Petrographic examination of these separated fractions shows a concentration of the maceral and mineral groups in the appropriate fractions. It is proposed that the selective separation of the most reactive macerals, as well as of those minerals that exhibit a catalytic effect, can enhance the efficiency of coal conversion. DOE

N82-12264# California Univ., Livermore. Lawrence Livermore Lab.
DESIGNING PROCESS WELLS FOR AN UNDERGROUND COAL-GASIFICATION ENVIRONMENT
D. S. Thompson Jun. 1981 20 p refs Presented at 7th Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 8 Sep. 1981
(Contract W-7405-eng-48)
(DE81-028434; UCRL-85839; CONF-810923-7) Avail: NTIS HC A02/MF A01

The reasons why process well integrity is important are covered in a review and evaluation of significant data generated from various field tests, including identification of well failure mechanisms. A close relationship is observed between process well behavior and process performance. As a logical extension of this evaluation, design and performance criteria for under-

ground coal gasification (UCG) process wells are developed. Applications to the next generation of field tests are presented in the form of proposed design features for UCG process wells, features intended to prevent the failure modes that have occurred in past field experiments. DOE

N82-12400# Oak Ridge National Lab., Tenn. Chemical Technology Div.

MEASUREMENT OF THERMAL CONDUCTIVITIES IN COAL FLUIDS

C. S. Chang, J. B. Bader, and J. L. Plawsky Sep. 1981 52 p refs

(Contract W-7405-eng-26)

(DE82-000523; ORNL/MIT-334) Avail: NTIS HC A04/MF A01

As a qualification of a transient hot wire, thermal conductivity cell for use on the Coal Liquids Flow System, the thermal conductivity of toluene was mesured between 25 and 850 C. Static measurements over a 4-sec time span yielded a thermal conductivity at 250 C of 0.12607 W/m-K and a slope of thermal conductivity vs temperature of -272.8 W/m-K (squared). All results are within 2 to 5% of the most recent literature data. An experimental error analysis showed all errors to be less than 1%. Dynamic-mode measurements in which flow through the cell was interrupted only for the measurement period agreed within experimental accuracy with the static-mode measurements, demonstrating that the hot-wire cell is immediately applicable to coal-slurry thermal-conductivity measurements in the Coal Liquids Flow System. Sedimentation experiments showed that settling should have a negligible effect on thermal-conductivity measurements over the time period envisioned for measurement. Excellent agreement was obtained between previous measurements of thermal conductivities of coal slurries and the predictions of the Rayleigh equation for heterogeneous-mixture thermal conductivities. DOE

N82-12514# University of Southern California, Los Angeles. Dept. of Petroleum Engineering.

FORMATION EVALUATION IN LIQUID-DOMINATED GEOTHERMAL RESERVOIRS

Iraj Ershaghi, Elmer E. Dougherty, and Lyman L. Handy Apr. 1981 106 p refs

(Contracts DE-AT03-76ET-28384; EY-76-S-03-0113)

(DOE/ET-28384/T1) Avail: NTIS HC A06/MF A01

Studies relative to some formation evaluation aspects of geothermal reservoirs are reported. The particular reservoirs considered were the liquid dominated type with a lithology of the sedimentary nature. Specific problems of interest included the resistivity behavior of brines and rocks at elevated temperatures and studies on the feasibility of using the well log resistivity data to obtain estimates of reservoir permeability. Brine viscosity data at elevated temperatures, effect of dissolved gases on brine resistivity, design of a modified API filter test apparatus, and modeling of filter cake buildup during drilling are discussed. DOE

N82-12516# Union Oil Co. of California, Los Angeles. Geothermal Div.

GEOTHERMAL RESERVOIR ASSESSMENT: NORTHERN BASIN AND RANGE PROVINCE STILLWATER PROSPECT, CHURCHILL COUNTY, NEVADA Final Report, Apr. 1979 - Jul. 1981

D. L. Ash, R. F. Dondanville, and M. S. Gulati Aug. 1981 35 p

(Contract DE-AC08-79ET-27012)

(DE82-000529; DOE/ET-27012/1) Avail: NTIS HC A03/MF A01

The two wells were drilled to total depths of 6946 ft and 10,014 ft with no significant drilling problems. A maximum reservoir temperature of 353 F was measured at 9950 ft. The most productive well flow tested at a rate of 152,000 lbs/hr with a wellhead temperature of 252 F and pressure of 20 psig. Based upon current economics, the Stillwater geothermal prospect is considered to be subcommercial for the generation of electrical power. This synopsis of the exploratory drilling activities and results contains summary drilling, geologic, and reservoir information from two exploratory geothermal wells. DOE

N82-12517# California Dept. of Conservation, Sacramento. Div. of Mines and Geology.

GEOPHYSICAL SURVEY, PASO ROBLES GEOTHERMAL AREA, CALIFORNIA, PART OF THE RESOURCE ASSESSMENT OF LOW- AND MODERATE-TEMPERATURE GEOTHERMAL RESOURCE AREAS IN CALIFORNIA Progress Report, 1979 - 1980

R. H. Chapman, Gordon W. Chase, and Les G. Younds 10 Nov. 1980 42 p refs

(Contract DE-FG03-79ET-37035)

(DE81-026038; DOE/ET-37035/T2) Avail: NTIS HC A03/MF A01

Some general background information concerning the geology and geothermal occurrences in the Southern Coast Ranges is included, as well as the more detailed information dealing with the Paso Robles area proper. Results from ground magnetic and gravity surveys, are discussed and interpreted. There is possible correlation in some places with known and suspected faults. There are also suggestions of local differences in the Tertiary rocks. DOE

N82-12518# California Dept. of Conservation, Sacramento. Div. of Mines and Geology.

RESOURCE ASSESSMENT OF LOW AND MODERATE-TEMPERATURE GEOTHERMAL WATERS IN CALISTOGA, NAPA COUNTY, CALIFORNIA Progress Report, 1979 - 1980

Les G. Youngs, C. Forrest Bacon, Rodger H. Chapman, Gordon W. Chase, Chris T. Higgins, Hasmukhrai H. Majmundar, and Gary C. Taylor 10 Nov. 1980 394 p refs

(Contract DE-FG03-79ET-37035)

(DE81-025559; DOE/ET-37035/T1) Avail: NTIS HC A17/MF A01

The USGS Geotherm file for California was updated and completed and the final data were compiled for a geothermal resources map of the State. The methodology used to determine the depth, configuration, flow rate, capacity, water quality, and location of the hottest water in the reservoir at Calistoga is described. The historical use of the resource is reviewed. Other aspects considered include general geology, magnetic surveys, gravity surveys, seismic reflection, and electrica resistivity of the resource. The hydrology and groundwater quality are related to the geological structure and formation as well as to resource assessment. The development of models for volume and temperature, and explatory drilling are also discussed. DOE

N82-12523# Office of Energy Resources, Augusta, Maine.

PEAT RESOURCE EVALUATION: STATE OF MAINE Quarterly Report

Joel Davis and Walter Anderson 1981 7 p

(Contract DE-FG18-79FC-14690)

(DE82-000227; DOE/FC-14690/T1) Avail: NTIS HC A05/MF A01

The amount and location of fuel-grade peat that may be harvested and utilized in an environmentally acceptable manner in Maine were surveyed. The resources inventory provides a detailed evaluation of the peat deposits including maps showing areal extent, thickness, and distribution of peat, stratigraphic cross sections, and surficial mapping. Many deposits were visited to accurately assess the physical characteristics of the deposits and to obtain laboratory samples. Representative samples from surveyed deposits are obtained through standard field sampling techniques. DOE

N82-12524# North Carolina Univ., Chapel Hill. Dept. of Geology.

PEAT DEPOSITS OF DISMAL SWAMP POCOSINS: CAMDEN, CURRITUCK, GATES, PASQUOTANK, AND PERQUIMANS COUNTIES, NORTH CAROLINA

R. L. Ingram and Lee J. Otte, (Kent State Univ., Ohio) Jul. 1981 31 p refs

(Contract DE-AC01-79ET-14693)

(DE81-029642; DOE/ET-14693/T3) Avail: NTIS HC A03/MF A01

The presence of peat is examined in the Dismal Swamp of northeastern North Carolina and southeastern Virginia. The deposits in North Carolina occupy an area of 76,800 acres containing about 68 million tons of moisture free peat. The deposits greater than 4 ft thick occupy an area of 34,700 acres containing about 43 million tons of peat. The surface elevation of the peat ranges from 15 to 20 ft. Two main types of peat are present: (1) a brown, decomposed fibrous peat usually found at the base of the thicker peats, and (2) a black, fine grained,

highly decomposed peat that usually overlies the fibrous peat. Both peat types contain large amounts of wood. The moisture content ranges from 40 to 94% and usually increases with depth and total thickness of the peat. It is found that heat values for moisture free, low ash peats range from 8700 to 10,900 Btu/lb and the sulfur content ranges from 0.2 to 0.7%. DOE

N82-12584# Century Engineering, Inc., Towson, Md.
EVALUATION OF LANDFILL GAS AS AN ENERGY SOURCE
Dec. 1980 45 p refs
(Contract DE-FG02-78IR-05106)
(DE82-000116; DOE/IR-05106/T47) Avail: NTIS HC A03/MF A01

The benefits and problems associated with landfill gas recovery were considered by the City of Baltimore, resulting in the structuring and testing of a realistic gas recovery evaluation procedure for use by local governments. The Baltimore methodology is summarized and results of its application to a large landfill in the Baltimore area are presented. The landfill gas generation process potential uses for the recovered gas, and treatment requirements are covered. DOE

N82-12595# Mid-American Solar Energy Complex, Minneapolis, Minn.
MASEC INDUSTRIAL FUEL-WOOD PROGRAM
M. Hohmann Jul. 1981 46 p refs
(Contract DE-AC02-79CS-30150)
(DE82-000461; MASEC/R-81-062; B-101-3) Avail: NTIS HC A03/MF A01

The program is designed not only to identify technical and institutional barriers to the use of wood for fuel, but to effectively reduce these barriers and the economic uncertainty they cause by providing business and industry with the type of information they need for preliminary planning purposes. Information on resource availability, the types of equipment needed, sources of technical assistance, and the financial aspects of the potential investment are provided. A listing of existing wood-fired systems is also included. A key component of the program is a net-cash-flow analysis based upon a life-cycle economic model that is used to evaluate new and retrofit wood-fired boiler installations. T.M.

N82-12596# Battelle Columbus Labs., Ohio.
ENERGY RECOVERY FROM MUNICIPAL SOLID WASTE AND SEWAGE SLUDGE USING MULTI-SOLID FLUIDIZED BED COMBUSTION TECHNOLOGY
Jul. 1981 210 p refs
(Contract DE-AC01-78CS-20424)
(DE82-001142; DOE/CS-20424/1) Avail: NTIS HC A10/MF A01

The concept is to recover energy as high and low pressure steam, simultaneously. High pressure steam would be generated from flue gas using a conentional tubular boiler. Low pressure steam would be generated by direct contact drying of DSS (as 4 percent solids) with hot sand in a fluidized bed that is an integral part of the MS-FBC process. It is proposed that high pressure steam could be used for district heating or electricity generation. The low pressure steam could be used for close proximity building heat. The results of the investigation show that the MS-FBC process concept for the co-utilization of MSW and DSS is technically feasible and that the thermal efficiency of the process is 76 to 82 percent based on experiments conducted in a 70 to 85 lb/h pilot plant and calculations on three conceptual cases. DOE

N82-12605# United Technologies Corp., South Windsor, Conn.
DESIGN, CONSTRUCTION, AND OPERATION OF A FULL SCALE EXPERIMENTAL ANAEROBIC FERMENTATION FACILITY Final Report
Jun. 1981 235 p
(Contract DE-AC01-77ET-20009)
(DE81-029028; DOE/ET-20009/T1) Avail: NTIS HC A11/MF A01

A 25 ton per day anaerobic fermentation facility was designed to evaluate the technical and economic viability of producing fuel gas and an animal refeed product from the residues of an environmental beef cattle feedlot. The system has been in continuous operation and has been producing between 3 to 5 cubic feet of methane per pound of volatile solids fed to the system. Product gas is successfully utilized in: (1) the system process boiler which maintains thermophilic operating temperature in the fermentors; (2) a meat packing plant process boiler, cofired with fuel oil; (3) and a 440 kW grid connected engine/generator system. Feeding trials that will establish the value of the dewatered effluent were performed. It is indicated from the initial operation of the system that it will be a technically and economically viable process. DOE

N82-12620# Mid-American Solar Energy Complex, Minneapolis, Minn.
INTERACTIVE MODEL TO ASSESS ECONOMICS OF ANAEROBIC DIGESTION OF THE FARM
Aug. 1981 41 p
(Contract DE-AC02-79CS-30150)
(DE82-000452; MASEC/R-81-068) Avail: NTIS HC A03/MF A01

An interactive computer model, to provide economic assessment for on the farm anaerobic digestion systems was designed. The model is accessed as part of the MASEC Models Library. It consists of two phases: engineering analysis and economic analysis. User inputs are stored in a data base and may be retained for future use. Model outputs include a recap of user inputs, calculations for gas production, digester heat requirements, system revenues, yearly cash flow, and a graph of the net present value of the investment. The model is generalized so that nonfarm applications may also be analyzed. The program will work equally well for various digester designs such as continuously stirred reactors, plug flow systems, and fluidized bed columns. DOE

N82-12633# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
COSTS FOR ALTERNATIVE GRAIN-RESIDUE-COLLECTION SYSTEMS
Silvio J. Flaim, Bernie Neenan, Jan Dauve, and Harry P. Mapp, Jr. (Oklahoma State Univ., Stillwater) Jun. 1981 55 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-029072; SERI/TR-734-900) Avail: NTIS HC A04/MF A01

The costs for systems for corn and soybean production in Iowa are examined. All machinery field operations, fuel, other inputs, and labor requirements are identified for the base case with no residue harvest, and for residue harvest by stacks and large round bales, with the owner's equipment and for custom harvest. These five cases were developed for corn and soybeans for conventional and reduced tillage practices. Harvesting alternatives are compared on the basis of costs, fuel input requirements, and gross energy balances of residues collected less energy inputs. The cost of collecting corn and soybean residues varies widely over the collection and tillage systems examined. Other effects constant, the reduced tillage practice leads to a lower cost of harvest than conventional tillage, and stacks are always cheaper than large round bales; however, the former difference is greater than the latter. DOE

N82-12684 Texas Univ. at El Paso.
HEAT FLOW STUDIES AND GEOTHERMAL EXPLORATION IN WESTERN TRANS-PECOS TEXAS Ph.D. Thesis
Bruce D. G. S. Taylor 1981 339 p
Avail: Univ. Microfilms Order No. 8121977

The definition of possible geothermal resources in Trans-Pecos Texas, and a geothermal gradient map of the region are presented, based on nearly 200 temperature and gradient measurements. Several areas of high thermal gradient are located, notably in Presidio County, where several hot springs and wells exist. Possible mechanisms for the high gradients (and heat flow) here are discussed. A small high gradient area is also indicated in northeast El Paso County, and a geophysical investigation of this prospect is described. The proximity to the city of El Paso made this a prime target for resource evaluation. Geophysical methods employed include gravity, self-potential and electrical resistivity, the surveys culminating in a shallow drilling program to define the areal extent of the anomaly. Dissert. Abstr.

N82-12693# Geological Survey, Washington, D. C.
BIOGEOCHEMICAL EVIDENCE FOR SUBSURFACE HYDROCARBON OCCURRENCE, RECLUSE OIL FIELD, WYOMING: PRELIMINARY RESULTS
Mary C. Dalziel and Terrence J. Donovan 1980 14 p refs
(USGS-CIRC-837) Avail: NTIS HC A02/MF A01

Anomalously high manganese to iron ratios occurring in pine needles and sage leaves over the Recluse oil field, Wyoming

suggest effects of petroleum microseepage on the plants. This conclusion is supported by iron and manganese concentrations in soils and carbon and oxygen isotope ratios in rock samples. Seeping hydrocarbons provided reducing conditions sufficient to enable divalent iron and manganese to be organically complexed or adsorbed on solids in the soils. These bound or adsorped elements in the divalent state are essential to plants, and the plants readily assimilate them. The magnitude of the plant anomalies, combined with the supportive isotopic and chemical evidence confirming petroleum leakage, makes a strong case for the use of plants as a biogeochemical prospecting tool. Author

N82-12731# Geokinetics, Inc., Concord, Calif.
METEOROLOGICAL AND CLIMATOLOGICAL INVESTIGATION: REVIEW OF JANUARY - JUNE 1980 INVESTIGATIVE PERIOD
D. R. Lundberg and H. K. L. Spradlin Jul. 1981 31 p refs
(Contract DE-FC20-78LC-10787)
(DE81-030740; DOE/LC-10787/80) Avail: NTIS HC A05/MF A01

Since January 1979, a meteorological and climatological investigation for the purpose of establishing a microclimatic baseline has been continuously conducted at the Geokinetics oil shale research facility in eastern Utah. This report, however, presents the findings for only a six month segment (January 1 - June 30, 1980) of that ongoing investigation. Included in this report is a description of the program design, the handling and interpretation of the data, and program improvement considerations commended for inclusion into future segments of the investigation. DOE

N82-12735# National Academy of Sciences - National Research Council, Washington, D. C. Maritime Transportation Research Board.
MARITIME SUPPORT FOR OCEAN-RESOURCES DEVELOPMENT Final Report
Jun. 1981 188 p refs
(Contract N00014-75-C-0711)
(AD-A104730) Avail: NTIS HC A09/MF A01 CSCL 08/10

The issues associated with ocean development to determine their implication for the U.S. maritime industry have been examined. The examination embraced ocean energy systems, offshore oil and gas activities, food from the sea, deep seabed mining, and the use of ocean space. The requirements that ocean-resource development places on the maritime industry do not show sharp differences from one resource to the next. While the technological base on which the means of recovery and use of the resources can be built and deployed has been developed, more scientific work and technological development are needed. However, it is the committee's opinion that the true factors pacing the effort to bring many of the resources into use and to achieve the many benefits are of an economic, legal, and public-policy nature. Author (GRA)

N82-12921# Los Alamos Scientific Lab., N. Mex.
SPACE NUCLEAR SAFETY AND FUELS PROGRAM Progress Report
S. E. Bronisz, comp. Jul. 1981 14 p refs
(Contract W-7405-eng-36)
Avail: NTIS HC A02/MF A01

The use of (238) PuC2 in radioisotope power systems are discussed. Impact testing, module handling procedures, and nondestructive test data for encapsulated pellets are reported. DOE

N82-12985# Oklahoma Univ., Norman. School of Chemical Engineering and Materials Science.
DEVELOPMENT OF A THERMODYNAMIC PROPERTIES CORRELATION FRAMEWORK FOR THE COAL CONVERSION INDUSTRY, PHASE 1A Annual Report, 1 Sep. 1980 - 31 Aug. 1981
K. E. Starling, L. L. Lee, K. H. Kumar, M. R. Brule, S. Watanasiri, V. Gupta, M. H. Li, R. McFall, W. Chang, C. K. So et al 1981 33 p ref
(Contract DE-FG22-80PC-30249)
(DE81-030363; DOE/PC-30249/T2; AR-1) Avail: NTIS HC A03/MF A01

A three-parameter corresponding states framework developed originally for light hydrocarbons was modified to rapidly develop a practical thermodynamic properties prediction capability for the coal conversion industry. The three-parameter corresponding states correlation describes the thermodynamic behavior of pure nonpolar and slightly polar nonassociating coal fluids and mixtures for which the mixture constituents are known. Characterization techniques are outlined for converting distillation analysis of undefined mixtures (with composition available in terms of broad fractions) into representative pseudo components. Empirical correlations are developed to estimate the three corresponding states characterization parameters for each fraction from measurements made on the fraction (boiling point, specific gravity, molecular weight). Results for one and two ring polar and associating coal fluids indicate that an extension of the corresponding states methodology to associating fluids using a five-parameter correlation is possible. DOE

N82-13196# Occidental Research Corp., Irvine, Calif.
CONTROLLED-FLASH PYROLYSIS Quarterly Technical Progress Report, Apr. - Jun. 1981
K. Durai-Swamy, S. C. Che, C. B. Chen, R. Jain, S. S. Kim, and H. VonSchonfeldt Aug. 1981 55 p refs
(Contract DE-AC22-80PC-30264)
(DE82-000284; DOE/PC-30264/09; QTPR-3) Avail: NTIS HC A04/MF A01

Thirteen runs were made in the controlled flash pyrolysis unit with a coal feed rate of about 2 kg/hour. Preliminary material balance for these tests is presented. The laboratory scale (1 gm/min.) pyrolysis reactor was used to evaluate several model compounds as quench solvents. Free radical pyrolysis studies, using an electron spin resonance spectrometer, show that vapor phase radicals from coal pyrolysis resemble phenalenyl radical and that char placed on top of the pyrolyzing coal absorbs these vapor phase radicals effectively. DOE

N82-13244# California Univ., Livermore. Lawrence Livermore Lab.
SOVIET UCG EXPERIENCE SPECIFICALLY RELATED TO FIELD EXPERIMENTS IN THE UNITED STATES
D. U. Olness 8 Jul. 1981 6 p refs Presented at 7th Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 8 Sep. 1981
(Contract W-7405-eng-48)
(DE81-028642; UCRL-85919; CONF-810923-6) Avail: NTIS HC A02/MF A01

Soviet experiences with problems in underground coal gasification experiments reveal similarities to problems encountered in the United States. Aerodynamic considerations and problems with hole failure, override, reverse burn links, and other coal conversion/extraction related difficulties are discussed. M.D.K.

N82-13245# Oak Ridge National Lab., Tenn.
H-COAL PRODUCT PHYSICAL PROPERTIES MEASUREMENT Final Report
D. D. Lee Aug. 1981 21 p refs
(Contract W-7405-eng-26)
(DE81-029095; ORNL/TM-7915) Avail: NTIS HC A02/MF A01

Rheological and density measurements have been made on the H-Coal PDU reactor effluent samples, which used Wyodak coal. Characterization was done in the ORNL Coal Liquids Flow System. Apparent viscosities and shear rates were observed. The rheological data were fitted to both power law and Bingham plastic models. The apparent viscosities appeared to correlate to the amount of solids in the samples. DOE

N82-13247# Burns and Roe Industrial Services Corp., Paramus, N. J.
LOW/MEDIUM BTU COAL GASIFICATION ASSESSMENT PROGRAM FOR POTENTIAL USERS IN NEW JERSEY: EXECUTIVE SUMMARY
May 1981 21 p refs
(Contract DE-AC01-79RA-20216)
(DE81-025475; DOE/FE-20216/1) Avail: NTIS HC A02/MF A01

The production of medium Btu quality gas (MBG) for use as fuel for on-site power plant boilers or for distribution to industrial customers appeared to be economically attractive, dependent upon the proximity of sufficient numbers of industrial customers and upon high plant utilization. The Texaco Coal Gasification Process (TCGP) was selected, being a pressurized process capable of supplying the gas without downstream compression. The TCGP could handle the high sulfur eastern coals chosen as a feedstock. All equipment downstream of the gasifier was commercially proven. The integration of the gasification process

with a methanol synthesis plant, consuming up to 25% of the MBG produced, was desirable in order to allow storage of MBG during low demand and thereby increase the gasifier capacity factor and minimize its turndown requirements. DOE

N82-13248# Combustion Engineering, Inc., Windsor, Conn.
LOW-BTU GASIFICATION OF COAL FOR ELECTRIC POWER GENERATION, PHASE 1, 2, AND 3 Monthly Progress Report, 1 Apr. - 30 Apr. 1981
16 Aug. 1981 46 p refs
(Contract DE-AC01-76ET-10204)
(DE81-029482; DOE/ET-10204/T1; FE-1545-89) Avail: NTIS HC A03/MF A01

Oxygen-enriched operation of the Pressure Distribution Unit was initiated on April 1, 1981. Eleven oxygen enriched gasmaking tests were made during the month. These tests were interrupted upon eight occasions by slag tap pluggage or imminent pluggage. A 15 to 20 day opuations text was begun during the month, but not successfully completed owing to the tap hole plusggage problems. Iron reduced from the slag due to the low oxygen concentration in this region was the most obvious explanation for the tap hole pluggages. DOE

N82-13252# Ultrasystems, Inc., Irvine, Calif.
FEASIBILITY STUDY REPORT FOR THE IMPERIAL VALLEY ETHANOL REFINERY: A 14.9-MILLION-GALLON-PER-YEAR ETHANOL SYNFUEL REFINERY UTILIZING GEOTHERMAL ENERGY
Mar. 1981 202 p Prepared in cooperation with U.S. Alcohol Fuels, East Mesa, Calif.
(Contract DE-FG07-80RA-50308; Proj. 1013)
(DE82-000288; DOE/RA-50308/1) Avail: NTIS HC A10/MF A01

The construction and operation of a 14,980,000 gallon per year fuel ethanol from grain refinery is proposed. The refinery will use hot geothermal fluid from geothermal resources as the source of process energy. In order to evaluate the economic viability of the proposed project, exhaustive engineering, cost analysis, and financial studies were undertaken. The results of feasibility studies undertaken in geothermal resource, engineering, marketing financing, management, environment, and permits and approvals are presented. The project was found to be economically viable. DOE

N82-13473# Los Alamos Scientific Lab., N. Mex. Dept. of Meteorology
SPECTRA OVER COMPLEX TERRAIN
H. A. Panofsky, D. Larko (Research and Data Systems, Inc.), R. Lipschutz (NOAA, Boulder, Colo.), and G. Stone 1981 18 p refs Presented at the 4th U.S. Natl. Conf. on Wind Eng. Res., Seattle, 26-29 Jul. 1981 Submitted for publication
(Contract W-7405-eng-36)
(DE81-028734; LA-UR-81-2380; CONF-810742-1) Avail: NTIS HC A02/MF A01

Spectra were measured over land downwind of a water surface over hilltops escarpments, and over rolling farmland. The following hypotheses are used to explain the differences between these spectra: (1) wavelengths short compared to the fetch over the new terrain, spectral densities are in equilibrium with the new terrain; (2) wavelengths long compared to this fetch, spectral densities remain unchanged if the ground is horizontal. If the flow is over a steep hill, the low frequency structure is modified by distortion of the mean flow, with the longitudinal component losing energy relative to the lateral and vertical components. It is found that vertical velocity spectra contain relatively less low frequency energy than horizontal velocity spectra, energetic vertical velocity fluctuations tend to be in equilibrium with local terrain. DOE

N82-13476# Minnesota Univ., Minneapolis. Limnological Research Center.
DEVELOPMENT OF PEATLANDS IN NORTHERN MINNESOTA Technical Progress Report
H. E. Wright, Jr. Sep. 1981 5 p refs
(Contract DE-AC02-80EV-10414)
(DE82-000873; DOE/EV-10414/T1) Avail: NTIS HC A02/MF A01

The extensive peatlands in northern Minnesota, which are considered as an energy resource through the development of a gasification operation were studied. Problems of peat mining, draining, reclamation, economic impact, wildlife, and vegetation are discussed. The history of formation of the major peatlands in northern Minnesota, and their relationship distribution and composition, to the modern and past climate and to the various natural factors and processes prevailing in the region are investigated. The following factors are considered: the formation of vegetation patterns that seem to be unique for North American peatlands, regional differences from east to west that may reflect trends in postglacial climate and forest composition, rates of peat formation in different environmental settings, and the record of atmospheric pollution (industrial contaminations, agricultural dust) that may be contained in short cores of peat. DOE

N82-13486# Pittsburg Univ., Pa. Dept. of Chemical and Petroleum Engineering.
WATER AND ENERGY USAGE IN COAL PREPARATION Final Report
S. H. Chiang and Robert E. Douglas May 1981 575 p refs Sponsored by the Geological Survey
(PB81-238248) Avail: NTIS HC A24/MF A01 CSCL 08I

The demand for water and energy by those industries physically beneficiating Eastern American coals was analyzed and predicted. Both the method and equipment utilized in cleaning coarse and fine coals were evaluated for their respective water and energy requirements. Five typical coal cleaning facilities employing various cleaning, comminution, screening, dewatering and drying equipment were simulated with a computer. Seven characteristic eastern coals (with ash and sulfur concentrations of 19-36 percent and 0.5-8.5 percent, respectively) were systematically evaluated in the conceptual coal preparation plants. GRA

N82-13488# Bureau of Mines, Pittsburgh, Pa.
CREATING A SAFER ENVIRONMENT IN US COAL MINES: THE BUREAU OF MINES METHANE CONTROL PROGRAM, 1964-79
Milford L. Skow, A. G. Kim, and M. Deul May 1981 57 p refs
(PB81-233918; BM-SP-5-81) Avail: NTIS HC A04/MF A01 CSCL 08I

The principal activities and results of 15 years of research on methane control in coal mines are summarized. Fundamental factors regarding the occurrence and movement of methane in coalbeds, removal of methane prior to mining, and control of methane during mining were investigated. Publications on methane control program, a section on methane recovery and use, a look at the upcoming Bureau of Mines research program, and a brief review of methane drainage practices in other coal producing countries are included. GRA

N82-13518# Oregon State Univ., Corvallis. Dept. of Atmospheric Science.
NETWORK WIND POWER OVER THE PACIFIC NORTHWEST. APPENDIX 1: WIND STATISTICS SUMMARIES FOR THE WIND POWER DATA STATIONS Progress Report, Oct. 1979 - Sep. 1980
R. W. Baker and E. W. Hewson Oct. 1980 122 p refs
(DE81-029291; DOE/BP-60) Avail: NTIS HC A06/MF A01

Tables and graphs are presented concerning monthly wind speed summaries; wind spectrum analyzer summaries; high wind speed summaries; and six hourly speed and direction plots for selected wind power sites. Wind flow plots in the Goodnoe Hills MOD-2 wind turbine area and wind flow plots in the Goodnoe Hills and Juniper Point area are included. DOE

N82-13520# Sandia Labs., Albuquerque, N. Mex.
GEOTHERMAL-RESOURCE VERIFICATION FOR AIR FORCE BASES
P. R. Grant, Jr. Jun. 1981 56 p refs
(Contract DE-AC04-76DP-00789)
(DE81-027482; SAND-81-7123) Avail: NTIS HC A04/MF A01

The various tupe of geothermal energy and legal uncertainties of the resource are summarized. A methodology to evaluate geothermal resources for applications to US Air Force bases is described. Estimates suggest that exploration costs will be $50,000 to $300,000 which, if favorable, would lead to drilling a $500,000 exploration well. Successful identification and development of a geothermal resource could provide all base, fixed system needs with an inexpensive, renewable energy source. T.M.

N82-13538# Oak Ridge Associated Universities, Tenn. Labor and Policy Studies Program.
BIOMASS ENERGY SYSTEMS: DESCRIPTIONS AND EMPLOYMENT REQUIREMENTS FOR TYPICAL OPERATIONS
S. E. Bell and Joanna R. Little Sep. 1981 90 p
(Contract DE-AC05-76OR-00033)
(DE82-000236; ORAU-185) Avail: NTIS HC A05/MF A01

Operations related to biomass energy feasibility studies, and expert opinion which as the basis for the typical facility description and employment estimates are reported. Biomass energy facilities are small by comparison to other energy sector operations, they have a sizable impacts on the communities and regions in which they are located. The employment and earnings generated during construction, operation, and maintenance provide an important stimulus to local economies. The facility descriptions estimated employment and earnings implications provide a first approximation of what is expected as the use of biomass energy systems increases. DOE

N82-13641# Dynatech Corp., Cambridge, Mass.
BIOMETHANATION OF BIOMASS PYROLYSIS GASES Final Report
C. A. Tracy and E. Ashare Aug. 1981 130 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-000238; SERI/TR-98356-1) Avail: NTIS HC A07/MF A01

The development of the biological methanation process and conditions for maximum performane were studied. Gasification processes have the potential to produce a synthesis gas from biomass. The advantage of such processes is that all organic components of the biomass may be converted to synthesis gas. However, this low Btu value gas is of limited use as a fuel gas. To convert the synthesis gas into pipeline qulity methane, a methanation process is necessary. A more economical alternative to catalytic methanation at high temperature and pressure is the utilization of a biological system to carry out the conversion of biomass pyrolysis gases to methane. DOE

N82-13646# Pau Univ. (France).
MICROEMULSIONS, EMULSIONS AND RELATED SYSTEMS: ENERGY APPLICATIONS [MICROEMULSIONS, EMULSIONS ET SYSTEMES CONNEXES: APPLICATIONS ENERGETIQUES]
1980 29 p refs In FRENCH Presented at Journee d'Etudes on Emulsions, Microemulsions et Systemes Connexes, Agents de Recuperation, de Stockage et de Transformation d'Energie, Pau, France, 25 Jan. 1980
Avail: NTIS HC A03/MF A01

Summaries of 16 lectures are presented. Topics include: oil recovery, thermodynamics of surface-active agents and microemulsions, interpretation of properties particular to alcohols in water-alcohol-oil ternary systems, phase diagrams and interfacial properties of the system water-dodecane-pentenol-sodium octylbenzene sulfonate, and modeling structural inversion in microemulsions. Other subjects are: numerical study of diphasic one and two dimensional flow in a porous medium, storage and transport of low temperature thermal energy as latent heat in dispersed systems, and the dynamics of nonNewtonian solutions. Author (ESA)

N82-13678 West Virginia Univ., Morgantown.
PYROLYTIC CHARACTERIZATION OF THE ORGANIC MATTER IN SELECTED COALS AND IN THE DEVONIAN SHALES OF SOUTHERN WEST VIRGINIA Ph.D. Thesis
Peter Alexander Kelley 1980 275 p
Avail: Univ. Microfilms Order No. 8123953

Selected whole coal samples from the coal sequence in West Virginia and shale samples of the Devonian black shales collected throughout southern West Virginia were subjected to pyrolytic analysis. Pyrograms characteristically showed two main groups of peaks, the first group of peaks representing the volume of hydrocarbons already present in the samples which are volatilized during the heating interval 40 C to 405 C, while the second group of peaks represents the hydrocarbons and related compounds generated during the 405 C to 700 C interval. All coal pyrograms gave a maximum in the pyrolysis curve which occurred in 400 C to 600 C temperature range. The degree of maturation of the organics in the Devonian shale samples was evaluated using the temperature of the maximum hydrocarbon generation during pyrolysis from 405 C to 700 C and the transformation ratio. The peak area units and relative values were used to evaluate the organic richness genetic potential, and hydrocarbon proportions in the Devonian shale samples. Dissert. Abstr.

N82-13619 Northwestern Univ., Evanston, Ill.
APPLICATION OF BAYESIAN ANALYSIS FOR WIND ENERGY SITE EVALUATION Ph.D. Thesis
Harish Govinda Rao 1981 142 p
Avail: Univ. Microfilms Order No. 8124987

Extensive research had indicated that the wind speed is well modelled by the single-parameter Rayleigh distribution. The site mean wind speed is given a prior distribution obtained from historical National Weather Service data of sites in the region. The prior distribution is updated to a posterior each time observed data become available. The posterior distribution is combined with the Rayleigh distribution to obtain the Bayesian distribution of wind speed. This distribution can be used in conjunction with the turbine power characteristics of different machines to make rational decisions, based on the expected maximum utility criterion, for selecting the best turbine for a given site or the best site for a given turbine. Dissert. Abstr.

N82-13627# Pacific Northwest Lab., Richland, Wash.
NUMERICAL WIND-SPEED SIMULATION MODEL
J. V. Ramsdell, G. F. Athey, and M. Y. Ballinger Sep. 1981 88 p refs
(Contract DE-AC06-76RL-01830)
(DE82-000956; PNL-3864) Avail: NTIS HC A05/MF A01

A stochastic model for simulating wind speed time series that can be used as an alternative to time series from representative locations is described. The model incorporates systematic seasonal variation of the mean wind, its standard deviation, and the correlation speeds. It also incorporates systematic diurnal variation of the mean speed and standard deviation. Model capabilities, are simulated and results of analysis of simulated and actual data are compared. DOE

N82-14317# Delaware Univ., Newark. Center for Catalytic Science and Technology.
DEVELOPMENT OF SUPERIOR DENITROGENATION AND ISOMERIZATION CATALYSTS FOR PROCESSING CRUDE OIL DERIVED FROM SHALE, PART 1 Final Interim Report
James R. Katzer, Alvin B. Stiles, and Harold Kwart 15 Aug. 1981 23 p refs
(Contract N00019-80-K-0507)
(AD-A105667) Avail: NTIS HC A02/MF A01 CSCL 08/7

For purposes of immediate application to shale oil, the most important conclusions derived from this preliminary work are the following: (1) As with quinoline, total nitrogen removal in multiring condensed heterocycled amines involves hydrogenation of the aromatic rings followed by (an often slower) process of C-N bond scission. (2) With multiring substrates of this nature the ring hydrogenation occurs more rapidly than the C-N bond scission reactions leading to the accumulation of considerable concentrations of hydrogenated nitrogen-containing species in the reaction mixture. (3) The overall rates of N-removal do not vary significantly because the rates of C-N bond scission in these hydrogenated species are quite similar. (4) The rates of these reactions would appear to be somewhat affected by steric hindrance to adsorption caused by the puckered cyclohexane rings and the similarity of rates must be due to the similarity of the steric effects. GRA

N82-14323# Sandia Labs., Albuquerque, N. Mex.
CATALYTIC EFFECT OF IRON IN HYDROGASIFICATION OF COAL
T. D. Padrick, D. D. Dees, and T. M. Mascis 1981 9 p refs Presented at the 11th North Am. Thermal Analysis Soc. Conf., New Orleans, 19 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE81-023928; SAND-81-0715C; CONF-811014-2) Avail: NTIS HC A02/MF A01

Results indicate that finely divided hematite enhances the production of methane, by a factor of fifteen, during char gasification at one atmosphere of hydrogen. Gasification rates were measured by heating the samples in a thermal gravimetric analysis system to a fixed temperature and then monitoring the rate of weight loss versus time. Product gas analysis indicates that during char gasification with hematite present, greater than 85 mole % of the gas is methane. The catalytic form of the

hematite was identified as reduced iron. The effect of the reduced iron as a catalyst is strongly dependent on particle size. The catalytic activity is also dependent on precursor species with the following order observed: Fe2O3, Fe3O4, FeS2, Fe. DOE

N82-14371*# United Technologies Research Center, East Hartford, Conn.
EXTERNAL FUEL VAPORIZATION STUDY Final Report
E. J. Szetela and J. A. TeVelde Nov. 1981 92 p refs
(NASA-CR-165513; UTRC-81-915326-15) HC A05/MF A01 CSCL 21D

The feasibility of external fuel vaporization in advanced aircraft gas turbine engines is addressed. Experiments were run to determine key fuel properties including boiling points, dew points, critical temperature, critical pressure, heat transfer coefficients, deposit formation rates, and deposit removal in a flowing system. Of particular concern were the heat transfer rate in the heat exchanger and the performance of the orifice used in the throttling process. Three fuels were utilized in the experiments including Jet-A, Experimental referee broad specification fuel, and a premium No. 2 diesel fuel. Engine conditions representing the NASA Energy Efficient Engine at sea level takeoff, cruise, and idle were simulated in the vaporization system and it was found that single phase flow was maintained in the heat exchanger and downstream of the throttle. Deposits encountered in the heat exchanger represented a thermal resistance as high as .0013 sq M K/watt and a deposit formation rate as high as 800 micro-gC/sq cm hr. These values are equivalent to a buildup of 0.055 cm of thickness in 36 hours resulting in a more severe fouling condition than originally anticipated. It was found that the deposit can be removed by cleaning with air at a temperature of 720 K for 10 minutes. R.J.F.

N82-14374# Department of Energy, Laramie, Wyo. Energy Technology Center.
SIXTH UNDERGROUND COAL-CONVERSION SYMPOSIUM
1980 619 p refs Symp. held in Shangri-la, Okla., 13-17 Jul. 1980 Prepared in cooperation with Williams Bros. Engineering Co., Tulsa, Okla.
(DE81-027669; CONF-800716) Avail: NTIS HC A99/MF A01

Department of Energy underground coal gasification (UCG) field programs at different sites are reviewed. Private sector industrial activity in UCG is reported. Mathematical modeling for UCG processes is discussed. Laboratory studies concerning UCG are presented. Environmental studies concerning specific UCG sites are examined. The economics of UCG are addressed. Instruments and controls are considered. General topics relevant to UCG are included. DOE

N82-14375# Lincoln Land Community Coll., Springfield, Ill.
ALCOHOL FUELS GRANT PROGRAM AT LINCOLN LAND COMMUNITY COLLEGE, SPRINGFIELD, ILLINOIS Final Report
1981 14 p
(Contract DE-FG02-80IR-1855)
(DE82-000744; DOE/IR-10855/T1) Avail: NTIS HC A02/MF A01

Progress in the development of alcohol fuels is reported. A tristar still was produced during demonstrations and workshops. Two cars were converted to run on the fuel produced from the still. Preliminary trials of a converted tractor using ethanol and water are reported. Information on the curriculum developed as part of this program is presented. DOE

N82-14377# Andco Environmental Processes, Inc., Buffalo, N.Y.
FEASIBILITY STUDY FOR AN ALCOHOL-FUELS PLANT FOR BUFFALO, NEW YORK
Nov. 1980 369 p refs
(Contract DE-FG01-80RA-50357)
(DE82-000032; DOE/RA-50357/T1) Avail: NTIS HC A16/MF A01

A feasibility study was conducted of a 15,000,000 gal per year anhydrous ethanol plant to be located in the Buffalo area. All major aspects of the construction and operation of the plant were investigated. It is concluded that: (1) the volatile energy situation presents too much of a risk for bankers and investors unless the Department of Energy guarantees that they will purchase any alcohol not sold on the open market at a guaranteed price formula; (2) the complete plant design was prepared and it appears that there is very little technological risk in the process; (3) a suitable plant site is available with all necessary utilities and the plant equipment has been laid out for this site; (4) the plant easily complies with environmental, health, safety and socioeconomic requirements; (5) raw materials consisting of corn and coal are readily available in adequate quantity and at reasonable prices in the Buffalo area; (6) the distillers dried grains and the carbon dioxide can both be sold in their entirety at reasonable prices; and (7) capital cost and operating cost are such that the alcohol plant makes an attractive investment with reasonable payout and profit potential. DOE

N82-14379# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
COAL-OIL MIXTURES: AN ALTERNATIVE FUEL FOR THE COMMERCIAL MARKETS AND LARGE RESIDENTIAL MARKETS
Thomas A. Butcher and Robert J. Isler 1981 29 p refs Presented at the Intern. Conf. on Residential Solid Fuels, Portland, Oreg., 1 Jun. 1981
(Contract DE-AC02-76CH-00016)
(DE81-028335; BNL-29773; CONF-810674-2) Avail: NTIS HC A03/MF A01

Results are presented of a program aimed at promoting wide-spread use of coal-oil mixtures in large residential and commercial sector size oil-fired heating equipment. Fuel properties are discussed including viscosity, heating values, and effect of coal particle size. On-site mixing of COM is not considered practical for users in this size range and a number of central preparation plant projects are in progress. Options for on-site storage including the addition of paddle agitators, recirculation agitation systems, auxiliary tanks, and stable slurries are discussed. Fuel pump, controls, and atomizer modifications will be required as well. Special problems of sootblowers, cyclones, baghouses, and scrubbers are considered. DOE

N82-14380# Kerr-McGee Corp., Oklahoma City.
PROCESS DEVELOPMENT FOR IMPROVED SRC OPTIONS. KERR-MCGEE CRITICAL SOLVENT DEASHING AND FRACTIONATION STUDIES Final Report
R. A. Baldwin, R. E. Davis, L. D. Gillham, R. C. Janka, R. E. Leonard, and D. E. Rhodes Jul. 1981 108 p refs Sponsored by EPRI
(EPRI Proj. 1134-2)
(DE81-903785; EPRI-AP-1932) Avail: NTIS HC A06/MF A01

The solvent refined coal 1/2 process, a coal liquefaction process which includes Kerr-McGee critical solvent deashing (CSD), was demonstrated in a blocked-out fashion in continuous bench-scale units. It was demonstrated that conventional SRC-I as well as short-residence-time vacuum bottoms could be successfully deashed and fractionated and that the fractionated portion of the soluble coal product, light SRC, could be added to the liquefaction solvent to improve its quality. An amount of light SRC equivalent to that which was initially added to the liquefaction solvent was recovered in the CSD process in most cases to maintain light SRC recycle. It was found that soluble coal product recovery was inversely proportional to the first-stage CSD temperature and that the fractionation step was sensitive to deashing solvent to feed ratio. The SRC-1/2 process was not, however, fully integrated and therefore these results are not necessarily indicative of steady-state conditions. DOE

N82-14381# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
POTENTIAL SUPPLY OF SYNTHETIC FUELS FROM ALASKAN HYDROELECTRIC POWER AND COAL
Meyer Steinberg and James R. Powell 1981 15 p refs Presented at the IGRC 1981 Conf., Chicago, 28 Sep. 1981
(Contract DE-AC02-76CH-00016)
(DE81-025743; BNL-29764; CONF-810933-1) Avail: NTIS HC A02/MF A01

It is proposed to develop and utilize the large potential hydroelectric power resources in Alaska to produce hydrogen by the electrolytic decomposition of water and to combine the hydrogen with the large Alaskan coal reserves to produce synthetic liquid and gaseous fuels. It is estimated that in this manner, as much as 1.8 million bbls/day of gasoline or 6.2 billion SCF/day of substitute natural gas can be produced. The existing and projected Alaskan pipelines would provide the means of transporting the fuels to energy consuming load centers in the

U.S. This development would move the US a considerable way towards energy independence as well as employing the material resources in Alaska in an efficient manner. DOE

N82-14383# Battelle Pacific Northwest Labs., Richland, Wash.
BIOMASS ENERGY UTILIZATION IN THE PACIFIC NORTHWEST: IMPACTS ASSOCIATED WITH RESIDENTIAL USE OF SOLID FUELS
P. Petty, W. Hopp, and A. Chockie May 1981 23 p refs Presented at the 1981 Intern. Conf. on Residential Solid Fuels, Portland, Oreg., 1 Jun. 1981
(Contract DE-AC06-76RL-01830)
(DE81-029137; PNL-SA-9618; CONF-810674-3) Avail: NTIS HC A02/MF A01

The Pacific Northwest Region, including Washington, Oregon, and Idaho, is the geographic area for which an impact assessment of the residential use of solid fuels is performed. An estimate of the potential energy contained in the fuelwood burned annually and an estimate of the mean conversion efficiency of the regional capital stock of woodburning appliances leads to a reasoned assessment of the contribution of wood energy to the residenital energy use in the region. The use of solid fuels was associated with an increase in the incidence of residential fires nationally. An estimate is made of the economic costs attributable to this source of fire incidence. An additional area of concern relates to the harvesting practices of hundreds of individuals, cutting fuelwood for their own use. Statistics describing injuries and death per Btu in the commercial logging industry are used as a basis for an estimate of injuries and deaths resulting from the increased collection of forest residues and fuelwood by private woodcutters. DOE

N82-14385# Punjab Agriculture Univ., Ludhiana (India). Coll. of Agricultural Engineering.
ENERGY BALANCE AND UTILIZATION OF AGRICULTURAL WASTE ON A FARM Final Report
B. S. Pathak, A. P. Bhatnagar, Dalijit Singh, and K. S. Salariya 1980 90 p refs Sponsored in part by Tata Energy Research Inst.
(PB81-229262) Avail: NTIS HC A05/MF A01 CSCL 21D

The possibility of using crop residues and other agricultural works as a renewable energy source is investigated. Some conclusions drawn are: energy requirements of tractor operated farms are only marginally higher than bullock operated farms; the use of commercial fuels for cooking in rural areas is very limited; most crop residues except paddy straw is used for fodder or fuel; farmers use dung as fuels although they know its use as a fertilizer; all energy required by farms could be self-generated; and paddy straw should be burned to produce electricity. GRA

N82-14386# Punjab Agriculture Univ., Ludhiana (India). Coll. of Agricultural Engineering.
STUDIES ON SUGARCANE AS AN ENERGY CROP FOR PUNJAB Final Report
B. S. Pathak, A. P. Bhatnagar, Dalijit Singh, and K. S. Salariya 1980 25 p refs Sponsored in part by Tata Energy Research Inst.
(PB81-232308) Avail: NTIS HC A02/MF A01 CSCL 21D

The energy costs and returns in the production of sugar cane and its conversion to alcohol, based on data collected from a sugar mill and a brewery, are presented. Author (GRA)

N82-14522# Petro-Lewis Corp., Denver, Colo.
FIELD DEMONSTRATION OF THE CONVENTIONAL STEAM DRIVE PROCESS WITH ANCILLARY MATERIALS Quarterly Report, Jul. - Sep. 1980
David R. Alden and Rod L. Eson (Chemical Oil Recovery Co., Bakersfield, Calif.) 7 Oct. 1980 13 p
(Contract DE-FC03-79SF-10762)
(DE81-026849; DOE/SF-10762/T2) Avail: NTIS HC A02/MF A01

This field test demonstrates an improved oil recovery process through the use of ancillary materials to steam drive injectors. The ancillary materials are used to reduce injection in steam channels and thus force the injected steam to enter alternate flow paths. Evaluation of the injection well production curves shows that currently there is over 125 incremental barrels of oil per day being produced by the four patterns receiving ancillary materials and that the incremental oil rate has been steadily increasing since the initial treatment in January, 1980. Preliminary work began on the evaluation of the producing temperatures, steam injection profiles, chemical tracer surveys, casing vent gas emissions and residual oil saturations in the six observation wells drilled. DOE

N82-14523# Chemical Oil Recovery Co., Bakersfield, Calif.
FIELD DEMONSTRATION OF THE CONVENTIONAL STEAM DRIVE PROCESS WITH ANCILLARY MATERIALS Quarterly Report, Oct. - Dec. 1980
Rod L. Eson and A. M. Shannon (Petro-Lewis Corp., Denver) Jan. 1981 28 p
(Contract DE-FC03-79SF-10762)
(DE81-026962; DOE/SF-10762/T1) Avail: NTIS HC A03/MF A01

This field test demonstrates an improved oil recovery process through the use of ancillary materials to steam drive injectors. The ancillary materials are used to reduce injection in steam channels and thus force the injected steam to enter alternate flow paths. During the first two months of this quarter up to 190 incremental barrels of oil per day were produced by the four patterns receiving ancillary materials. The evaluation of the producing temperatures, steam injection profiles, chemical tracer surveys, casing vent gas emissions and residual oil saturations in the six observation wells drilled is addressed. DOE

N82-14561# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SEASAT COMMERCIAL DEMONSTRATION PROGRAM
S. W. McCandless (User Systems Engineering, Annandale, Va.), B. P. Miller (Econ, Inc., Princeton, N.J.), and D. R. Montgomery *In* ESA Appl. of Remote Sensing Data on the Continental Shelf Jul. 1981 p 59-72 refs (For primary document see N82-14553 05-43)
Avail: NTIS HC A13/MF A01; ESA, Paris FF 125

The background and development of the Seasat commercial demonstration program are reviewed and the Seasat spacecraft and its sensors (altimeter, wind field scatterometer, synthetic aperture radar, and scanning multichannel microwave radiometer) are described. The satellite data distribution system allows for selected sets of data, reformatted or tailored to specific needs and geographical regions, to be available to commercial users. Products include sea level and upper atmospheric pressure, sea surface temperature, marine winds, significant wave heights, primary wave direction and period, and spectral wave data. The results of a set of retrospective case studies performed for the commercial demonstration program are described. These are in areas of application such as marine weather and ocean condition forecasting, offshore resource exploration and development, commercial fishing, and marine transportation. Author (ESA)

N82-14583# Bergen Univ. (Norway). Dept. of Chemistry.
OIL SPILL IDENTIFICATION BY CHEMICAL ANALYSIS
O. Grahl-Nielsen and S. Wilhelmsen (Inst. of Marine Research, Bergen) *In* ESA Appl. of Remote Sensing Data on the Continental Shelf Jul. 1981 p 243-244 refs (For primary document see N82-14553 05-43)
Avail: NTIS HC A13/MF A01; ESA, Paris FF 125

Gas chromatographic analyses of the relative amounts of phenanthrene and dibenzothiophene and their alkylated derivatives are shown to distinguish crude oils from different parts of the world and crude oils from different fields in the North Sea Ekofisk area. These aromatic hydrocarbons are relatively unaffected by weathering and can be used for matching oils from oil spills with unweathered samples from the suspected source. The method was used to identify the source of an oil spill in Bergen harbor. It is shown that analysis of the relative amounts of dibenzothiophenes is sufficient to discriminate between crude oils in most cases. Author (ESA)

N82-14594# Department of Energy, Laramie, Wyo.
BIBLIOGRAPHY OF PUBLICATIONS DEALING WITH TAR SANDS
Sep. 1981 296 p
(DE81-026146; DOE/LETC/RI-81/2) Avail: NTIS HC A13/MF A01

A compilation of technical reports, patents, journal articles and books on the development of tar sands (oil sands). The emphasis is on the US resource and its development. Included are articles on nondomestic tar sand and related heavy oil resources and their development. The subjects include: geology and resource evaluation; chemical and physical properties; in

situ recovery; upgrading and refining; history; environmental; and miscellaneous (includes general survey papers; resource development, health and safety, economics, etc.). DOE

N82-14695# Tetra Tech, Inc., Columbus, Ohio.
EVALUATION OF DEVONIAN SHALE POTENTIAL IN EASTERN KENTUCKY/TENNESSEE
1981 104 p refs
(Contract DE-AC21-79MC-10389)
(DE82-001164; DOE/METC-121) Avail: NTIS HC A06/MF A01

The US Department of Energy's Eastern Gas Shales Project is designed not only to identify the resource, but also to test improved methods of inducing permeability to facilitate gas drainage, collection, and production. Results as they pertain to the Devonian gas shales of the Appalachian basin in eastern Kentucky and Tennessee are presented. Geologic data and interpretations are summarized, and areas where the accumulation of gas may be large enough to justify commercial production are outlined. DOE

N82-14612# Department of Energy, Pittsburgh, Pa. Mining Technology Center.
LONGWALL MINING OF THIN SEAMS
Ernest A. Curth 1981 22 p refs Presented at the 1st Ann. Conf. on Ground Control in Mining, Morgantown, W. Va., 27 Jul. 1981
(DE81-028042; CONF-810714-2) Avail: NTIS HC A02/MF A01

Thin seam operations pose a challenge to the ingenuity of mining engineers to overcome the factor of human inconvenience in the restricted environment and associated high cost production. Suprisingly, low seam longwalls in the Federal Republic of Germany in an average thickness of 35 in. and dipping less than 18 deg come close to achieving the average production rate of all German longwall operations. They are all plow faces, and a consistent production of 3300 tons per dav and a productivity of 40 tons per man shift are reported from one of the thin seam longwalls. These results were attained by reliable high capacity equipment and roof support by shields that can be collapsed to as low as 22 inches. Maximum mining height for plow operated faces lies at 31.5 inches. Technology development for the future is discussed. DOE

N82-14613# California Univ., Livermore. Lawrence Livermore Lab.
MATHEMATICAL MODELLING OF SOME CHEMICAL AND PHYSICAL PROCESSES IN UNDERGROUND COAL GASIFICATION
John R. Creighton Aug 1981 5 p Presented at the Eastern Section: The Combustion Inst. Conf., Pittsburgh, 27-29 Oct. 1981 Submitted for publication
(DE81-027941; UCRL-86518; CONF-811027-1) Avail: NTIS HC A02/MF A01

The chemical and physical processes governing underground coal gasification were conducted on laboratory scale experiments accompanied by mathematical modelling. Blocks of selected coal types are cut to fit 55 gallon oil drums and sealed in place with plaster. A 1 cm. diameter hole is drilled the length of the block and plumbing attached to provide a flow of air or oxygen/steam mixture. After an instrumented burn the block is sawed open to examine the cavity. Mathematical modelling is directed towards predicting the cavity shape. Sub models and their impact on predicted cavity shapes are examined. DOE

N82-14614# Sandia Labs., Albuquerque, N. Mex. Geothermal Technology Development Div.
ACCESSING THE GEOTHERMAL RESOURCES
James R. Kelsey 1981 6 p refs Presented at the Showcase for Technol. Conf., Albuquerque, N. Mex., 28 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE81-025396; SAND-81-1384C; CONF-811018-1) Avail: NTIS HC A02/MF A01

The technology development efforts in the areas of drilling, completion, and logging instrumentation are described. These development efforts are aimed at solving the problems associated with the high temperatures, hard-fractured geological formations, and corrosive formation fluids. DOE

N82-14639# Pope, Evans, and Robbins, Inc., New York.
EVALUATION OF COAL GASIFICATION/COMBINED CYCLE POWER PLANT FEASIBILITY AT THE SEWELLS POINT NAVAL COMPLEX, NORFOLK, VIRGINIA Final Report
Jul. 1981 235 p refs
(Contract N62470-80-C-3736)
(AD-A103674) Avail: NTIS HC A11/MF A01 CSCL 10/2

The feasibility of installing a coal gasification/combined cycle cogeneration plant at Sewells Point Naval Complex, Norfolk, Virginia is evaluated. Current gasification technology, combined cycle thermodynamics, environmental control requirements, and conventional coal fired cogeneration cycles are addressed. The utility interface, site considerations, and economic analyses are also presented. It is concluded that a coal gasification/combined cycle cogeneration plant supplying 50 MW of electric power and 290,000 lb/hr of steam is technically feasible. M.D.K.

N82-14680# Oak Ridge National Lab., Tenn.
COAL CONVERSION SOLID WASTE DISPOSAL
C. W. Francis, W. J. Boegly, Jr., R. R. Turner, and E. C. Davis 1981 21 p refs Presented at the Am. Soc. of Civil Engr. Ann. Meeting, Vail, Colo., 3 Aug. 1981
(Contract W-7405-eng-26)
(DE81-028567; CONF-81085-1) Avail: NTIS HC A02/MF A01

The major solid waste produced at coal conversion facilities will be gasification slag or ash. To evaluate the impact of this waste on the environment, extensive characterization and leaching studies were conducted on ash/slags that were generated in bench-scale operations, pilot plants, and/or process development units for the Coges, British Gas/Lurgi, Grace/Texaco, U-Gas, Foster Wheeler/Stoic, SRC-I/Koppers-Totzek, SRC-II/Texaco, and Combustion Engineering gasification processes. These studies, designed to assess the consequences of disposal in landfills, showed that none of the leachates from these eight wastes exceeded the US Environmental Protection Agency's toxicity limits established as a result of the Resource Conservation and Recovery Act of 1976. The major environmental impact associated with disposal of these solid wastes appears to be the dissolution of sulfate and the potential acidification of ground water. DOE

N82-14711 Iowa Univ., Oakdale
STRATIGRAPHY AND DEPOSITIONAL HISTORY OF THE IOLA LIMESTONE UPPER PENNSYLVANIAN (MISSOURIAN), NORTHERN MIDCONTINENT U.S. Ph.D. Thesis
John Charles Mitchell 1981 379 p
Avail: Univ. Microfilms Order No. 8123341

The Iola Limestone, one of the best developed and most laterally extensive, yet least studied Missourian cyclic carbonates in the Midcontinent Upper Pennsylvanian, was studied. Along with adjacent shales, five members constitute the Iola cyclothem, a typical Kansas cyclothem. In ascending order these are: Chanute Shale; Paola Limestone; Munice Creek Shale; Raytown Limestone; and Lane/Bonner Springs Shale. Although traditional interpretation of cyclothems regarded all shale as nearshore, shallow-water deposits, Iola lithology and stratigraphy support the more recent hypothesis that the cyclothem represents a single transgressive-regressive event, with maximum transgression occurring during deposition of the Muncie Creek Shale. Distribution of conodonts reflects the depositional pattern of the Iola cyclothem. Vertical variation far outweighs lateral variation in abundance and diversity. Dissert. Abstr.

N82-15152# Oak Ridge National Lab., Tenn.
THERMOLYSIS OF NAPHTHOLS
M. L. Poutsma and C. W. Dyer 1981 6 p refs Presented at the Intern. Conf. on Coal Sci., Dusseldorf, 7 Sep. 1981
(Contract W-7405-eng-26)
(DE81-029684; CONF-810914-8) Avail: NTIS HC A02/MF A01

A significant portion of the oxygen content of native coals and of the coal-derived liquids used as process solvents during hydroliquefaction of coal is present as phenolic hydroxyl groups. Various reported phenomenological effects of the phenolic content of process solvents on liquefaction performance were reviewed. Background data concerning the chemical behavior of phenols under conditions representative of liquefaction were found lacking. The thermolysis of representative phenols under carefully defined conditions was studied. The behavior of the isomeric naphthols at 400 C in the absence of any purposely added reagents or catalysts is described. The results reveal a set of previously unrecognized thermal reactions by which phenols may be condensed to furans, be deoxygenated to arenes, and serve as

hydrogen donors. These processes, the latter two generally desirable and the former one undesirable, are inherently related. M.D.K.

N82-15185# National Bureau of Standards, Washington, D.C. High Temperature Processes Group.
VAPORIZATION AND CHEMICAL TRANSPORT UNDER COAL GASIFICATION CONDITIONS
J. W. Hastie, D. W. Bonnell, E. R. Plante, and W. S. Horton Dec. 1980 114 p refs
(Contract DOE-EA-77-A-01-6010)
(PB81-245839; NBSIR-80-2178-DOE) Avail: NTIS HC A06/MF A01 CSCL 07D

Transpiration mass spectrometry for the quantitative analysis of high vapor temperature gases and vapors is described. This technique was applied to vapor transport and thermodynamic activity determinations for real and synthetic coal slag samples in reactive coal gas components at atmospheric pressure. A highly nonideal and nonmonotonic (with temperature and composition variables) behavior for alkali metal vapor transport was indicated. Thus a priori predictions of alkali metal transport in coal gasifiers without actual activity data are virtually impossible at the present time. Surface segregation and diffusion limitations of alkali species in slags are also possible complicating effects. Author

N82-15221# Oak Ridge National Lab., Tenn. Engineering Technology Div.
FAILURE MODES AND EFFECTS ANALYSIS OF A COAL-SLURRY PREHEATER
H. A. Mitchell, L. F. Parsly, and A. N. Smith Sep. 1981 33 p refs
(Contract W-7405-eng-26)
(DE81-030425; ORNL/TM-7864) Avail: NTIS HC A03/MF A01

Some 55 potential failure modes were identified in a coal slurry preheater, a critical component in a typical coal direct liquefaction plant. Fourteen of these events, if they should occur, would result in losses of sufficient magnitude to require special consideration in the design or operating phase to assure control of risk at an acceptable level. It is concluded that the failure modes and effects analysis technique (FMEA) could be a valuable tool in the identification of critical components for coal conversion systems. For maximum effect, FMEA needs to be used during the initial design phase. Its principal value is to determine high-risk failure modes, which could have unacceptable impacts on system safety and reliability/availability. The usefulness of FMEA can be improved if it is supplemented by the development of a failure data base; this data base could also be of value in selected cases as input to a more detailed technique such as a fault-free analysis. DOE

N82-15222# Oak Ridge National Lab., Tenn. Engineering Technology Div.
COAL AND LIMESTONE FEED TESTING FOR ATMOSPHERIC FLUIDIZED BED COMBUSTION
C. S. Daw, J. F. Thomas, and M. E. Lackey Sep. 1981 78 p
(Contract W-7405-eng-36)
(DE81-030629; ORNL/TM-7724) Avail: NTIS HC A05/MF A01

Pneumatic conveying tests of coal and coal limestone mixtures were performed on a conveying system designed to represent the branch feed lines in the TVA 20 MW(e) atmospheric fluidized bed combustor pilot plant. Test conditions were chosen to cover the operating ranges anticipated for the pilot plant. These tests led to a basic understanding of the design and operating problems associated with coal surface moisture, air velocity, fines content, solids loading, and limestone to coal ratio. Coal surface moisture was found to be the most important parameter affecting handling properties. Above a critical level of about six %, surface moisture caused severe compaction problems in the feed hopper and impact plugging in the conveyor line. When surface moisture was less than six %, conveyor line plugging resulted only from saltation and filling. DOE

N82-15224# Department of Energy, Bartlesville, Okla.
MOTOR GASOLINES, WINTER 1980-81
E. M. Shelton Jul. 1981 67 p refs
(DE81-030845; DOE/BETC/PPS-81/3) Avail: NTIS HC A04/MF A01

A compilation of analytical data for 546 samples of motor gasoline produced by 23 manufacturers is presented. The data are tabulated by groups according to brands (unlabeled) and grades for 17 marketing districts into which the country is divided. A map showing marketing areas, districts, and sampling locations is induced. Trends of selected properties of motor fuels since 1959 are charted. Octane distribution percent charts for areas 1, 2, 3, and 4 for unleaded antiknock index (R + M)/2 below 90.0, unleaded antiknock index (R + M)/2 below 93.0, and leaded antiknock index (R + M)/2 93.0 and above grades of gasoline are presented. The antiknock (octane) index (R + M)/2 averages of gasoline sold in this country were 87.6 unleaded below 90.0, 91.4 unleaded 90.0 and above, 89.1 leaded below 93.0, and 93.3 leaded 93.0 and above grades of gasoline. DOE

N82-15225# Texas Univ., Austin. Bureau of Economic Geology.
ASSESSMENT OF IN-PLACE SOLUTION METHANE IN TERTIARY SANDSTONES: TEXAS GULF COAST
A. R. Gregory, M. M. Dodge, J. S. Posey, and R. A. Morton 1981 8 p refs Presented at the 5th Geopressured-geothermal Energy Conf., Baton Rouge, La., 13 Oct. 1981
(Contract DE-AC08-78ET-11397)
(DE81-029772; CONF-811026-5) Avail: NTIS HC A02/MF A01

The total volume of in place methane dissolved in formation waters of deep sandstone reservoirs of the onshore Texas Gulf Coast within the stratigraphic section extending from the base of significant hydrocarbon production (8000 ft) to the deepest significant sandstone occurrence is appraised. Reservoir bulk volume, porosity, and methane solubility were evaluated. The latter is controlled by the temperature, pressure, and salinity of formation waters. Regional assessment of the volume and distribution of potential sandstone reservoirs was made from a data base of 880 electrical well logs, from which a grid of 24 structural dip cross sections and 4 strike cross sections was constructed. These cross sections extend from near the Wilcox outcrop to the coastline. The structural and stratigraphic framework of Tertiary sandstone units was mapped. Structual and stratigraphic frame-boundaries were used to divide the Texas Gulf Coast into 24 subdivisions. Methane content in each of nine formations or divisions of formations was determined for each subdivision. The total in place methane for Tertiary sandstones below 8000 ft in the Texas Gulf Coast was found to be 690 TCF. The total in place methane for effective Tertiary sandstones (sandstone units greater than 30 ft thick) below 8000 ft was 325 TCF. DOE

N82-15226# Battelle Pacific Northwest Labs., Richland, Wash.
THERMOCHEMICAL PRODUCTION OF LIQUIDS FROM BIOMASS
D. C. Elliott 1981 8 p refs Presented at Solar World Forum, Brighton, England, 23 Aug. 1981
(Contract DE-AC06-76RL-01830)
(DE81-030085; PNL-SA-9246; CONF-810865-1) Avail: NTIS HC A02/MF A01

The chemistry of this process is essentially that of the CO-steam process wherein carbon monoxide and water, catalyzed by sodium carbonate, are the reducing agents for the biomass. A water slurry process involving a prehydrolysis step for wood chips has been used to produce the first biomass-derived oil on a large scale. A second variation which requires recycle of a portion of the product for use as the carrier vehicle for wood flour has also been developed to the point of producing multi-barrel quantities of product. An extensive amount of product analysis has been completed on both types of product. They are similar, being highly phenolic and approximately 10% by weight of oxygen. Utilization of the product as a boiler fuel has been tested and other uses of the product are now being investigated. Analytical results and product application tests are discussed. DOE

N82-15227# California Univ., Livermore. Lawrence Livermore Lab.
HIGH-PRESSURE SOLVENT EXTRACTION OF METHANE FROM GEOPRESSURED FLUIDS
R. Quong, H. H. Otuski, F. E. Locke, and R. Netherton Aug. 1981 6 p refs Presented at the 5th Geopressured-Geothermal Energy Conf., Baton Rouge, La., 13-15 Oct. 1981 Submitted for publication
(Contract W-7405-eng-48)
(DE81-027713; UCRL-86515; CONF-811026-2) Avail: NTIS HC A02/MF A01

Technical and economic aspects of solvent extraction as a

means of recovering dissolved methane from geopressured-geothermal brines at high pressures are considered. Economic assessment shows that additional investment in a high pressure solvent extraction plant preceding direct injection disposal of brines into isolated aquifers can be profitable. Solvent extraction is compared with other injection methods. The contributions of hydraulic (pressure) energy recovery and geothermal power production are also assessed. The solubilities of a promising solvent, n-hexadecane, and a potential low cost solvent, No. 2 Diesel fuel, were measured in 15 wt percent NaCl solutions at temperatures up to 150 C. Preliminary results of initial extraction tests at 150 C and 1000 psi in sub-pilot scale equipment are also presented. DOE

N82-15232# Massachusetts Inst. of Tech., Cambridge. LNG Research Center.
LIQUID NATURAL GAS RAPID PHASE TRANSITIONS Topical Report, Sep. 1979 - Sep. 1980
George A. Corbin and Robert C. Reid Jan. 1981 89 p refs Prepared for Gas Research Inst.
(PB81-244774; GRI-80/0031) Avail: NTIS HC A05/MF A01 CSCL 21D

An apparatus was constructed to test the concept of initiating a rapid phase transition (RPT) in methane-rich LNG on water by collapsing the vapor film with a shock wave. Helium overpressures were achieved by breaking a diaphragm in a high-pressure helium chamber. Pressure transducers recorded subsequent events. NORPT were noted for liquid nitrogen, liquid ethane, liquid methane or methane-rich LNG even with helium driver pressures up to 62 bar. The helium did, however, greatly enhance the boiling rate of the cryogen on water. On the basis of analytical modelling, it was concluded that a RPT would be very improbable for a methane-rich LNG contacting ambient water in a mode where the surface pressures were high. In the course of the project, a new thermodynamic model was developed as a possible explanation for a RPT in cases where the hot liquid temperature would exceed the critical temperature of the cryogen. GRA

N82-15233# Southwest Research Inst., San Antonio, Tex.
CHARACTERIZATION OF DIESEL EMISSIONS AS A FUNCTION OF FUEL VARIABLES Final Report, Sep. 1979 - Mar. 1981
Bruce B. Bykowski Mar. 1981 288 p refs
(Contract EPA-68-03-2707)
(PB81-244048; EPA/460-3-81-015) Avail: NTIS HC A11/MF A01 CSCL 21D

Several properties of a refinery 'straight run kerosene', which have a narrow boiling range approximating the middle of a No. 1 diesel fuel, were altered to study their effects on regulated and unregulated exhaust emissions. Eleven fuel blends, representing changes in nitrogen content, aromatic level, boiling point distribution, olefin content, and cetane number, were evaluated. Statistical analysis, including regression, was performed using selected fuel properties as independent variables. Higher aromatic levels are generally associated with increased emissions, while increased olefin levels are generally associated with decrease emissions. GRA

N82-15452# Ricardo & Co., Engineers (1927) Ltd., Shoreham-by-Sea (England).
THE UTILISATION OF ALCOHOL IN LIGHT DUTY DIESEL ENGINES Final Report
28 May 1981 41 p refs Sponsored by EPA
(PB81-244469; EPA-460/3-81-010; DP-61/935) Avail: NTIS HC A03/MF A01 CSCL 21G

Various approaches employed to facilitate the utilization of alcohols, methanol and ethanol, in light duty diesel engines were reviewed. The choice of which system to employ is most heavily influenced by the proportion of alcohol substitution which is required and the resulting engine first cost penalty which is deemed to be acceptable. Alcohol utilization by more or less conventional spark ignited engines appears to be far less problematical than conversion of diesel engines. GRA

N82-15489*# Geological Survey, Denver, Colo.
GEOLOGIC APPLICATIONS OF THERMAL-INERTIA MAPPING FROM SATELLITE Final Report
Terry W. Offield, Principal Investigator, Kenneth Watson, and Susanne Hummer-Miller Jul. 1981 109 p refs Original contains imagery. Original imagery may be purchased from NASA Goddard Space Flight Center, (Code 601), Greenbelt, Md. 20771. Domestic users send orders to 'Attn: National Space Science Data Center'; non-domestic users send orders to 'Attn: World Data Center A for Rockets and Satellites'. HCMM
(NASA Order S-40256-B)
(E82-10011; NASA-CR-164818) Avail: NTIS HC A06/MF A01 CSCL 08B

In the Powder River Basin, Wyo., narrow geologic units having thermal inerties which contrast with their surroundings can be discriminated in optimal images. A few subtle thermal inertia anomalies coincide with areas of helium leakage believed to be associated with deep oil and gas concentrations. The most important results involved delineation of tectonic framework elements some of which were not previously recognized. Thermal and thermal inertia images also permit mapping of geomorphic textural domains. A thermal lineament appears to reveal a basement discontinuity which involves the Homestake Mine in the Black Hill, a zone of Tertiary igneous activity and facies control in oil producing horizons. Applications of these data to the Cabeza Prieta, Ariz., area illustrate their potential for igneous rock type discrimination. Extension to Yellowstone National Park resulted in the detection of additional structural information but surface hydrothermal features could not be distinguished with any confidence. A thermal inertia mapping algorithm, a fast and accurate image registration technique, and an efficient topographic slope and elevation correction method were developed. Author

N82-15505# Texas Univ., Austin. Bureau of Economic Geology.
STRUCTURAL EVOLUTION OF THREE GEOPRESSURED-GEOTHERMAL AREAS IN THE TEXAS GULF COAST
Charles D. Winker, Robert A. Morton, and Deborah D. Garcia 1981 13 p refs Presented at the 5th Geopressured-Geothermal Energy Conf., Baton Rouge, La., 13 Oct. 1981
(Contract DE-AC08-79ET-27111)
(DE81-029799; CONF-811026-9) Avail: NTIS HC A02/MF A01

Detailed analysis of geological and seismic data from several geopressured geothermal areas (Cuero, Blessing, Pleasant Bayou) reveals similarities in structural-stratigraphic relationships that form geopressured aquifers as well as differences in structural complexity and evolution that characterize the different areas. In these examples, geopressured sandstones are isolated on the updip side by downfaulting against shelf-slope shales, and on the downdip side by unfaulting against transgressive marine shales. Moreover, they are isolated above and below by thick sequences of transgressive shale or interbedded sandstone and shale. Prospective reservoirs are found where deltaic and associated sandstones (distributary channel, delta front, barrie-strandplain) were deposited seaward of major growth faults and near the shelf margin. DOE

N82-15508# Gulf Universities Research Consortium, Bellaire, Tex.
RELATIONAL METHODOLOGY FOR INTEGRATING AND ANALYZING FIELD TEST AND RESEARCH DATA DESCRIBING ENHANCED OIL RECOVERY
Bill A. Bavinger, Scott Callaway, Donna Tice Goodbread, and James L. Gumnick Oct. 1981 154 p refs
(Contract DE-AC01-76ET-10145)
(DE81-030441; DOE/ET-10145/72) Avail: NTIS HC A08/MF A01

The application of concepts of relational analysis for the integration of two experimental data bases was demonstrated. The following data bases are created: the enhanced oil recovery field test data base; and the enhanced oil recovery research data base. DOE

N82-15509# University of Southern Mississippi, Hattiesburg. Dept. of Polymer Science.
IMPROVED POLYMERS FOR ENHANCED OIL RECOVERY SYNTHESIS AND RHEOLOGY Annual Report, Oct. 1979 - Sep. 1980
C. L. McCormick, R. D. Hester, H. H. Neidinger, and G. C. Wildman Apr. 1981 300 p refs
(Contracts DE-AS05-77ET-12038; EF-77-S-05-5603)
(DE81-030194; DOE/ET-12038/T3; AR-3) Avail: NTIS HC A13/MF A01

The synthesis, characterization, and rheological studies of random and graft copolymers which are used as models for mobility control agents in enhanced oil recovery are reported. The following procedures are studied: macromolecular syntheses

of model polymers, dilute solution viscosity, aqueous size exclusion chromatography, and laser light scattering. DOE

N82-15548# Sandia Labs., Albuquerque, N. Mex.
SANDIA PROGRAM IN GEOTHERMAL TECHNOLOGY DEVELOPMENT
J. R. Kelsey and B. C. Caskey 1981 4 p refs Presented at the Geothermal Resources Council Ann. Meeting, Houston, Tex., 25 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE81-025394; SAND-81-1490C; CONF-811015-4) Avail: NTIS HC A02/MF A01

The accomplishments of the geothermal research program, the status of current projects, and plans for future activities are presented. The program includes R and D in high temperature rock penetration mechanics, drilling fluids borehole mechanics, and diagnostics technology. DOE

N82-15552# SRI International Corp., Menlo Park, Calif.
EXPLORATORY STUDY OF COAL-CONVERSION CHEMISTRY Quarterly Report, 20 Jun. 1980 - 19 Sep. 1981
4 Mar. 1981 35 p refs
(DE81-016136; DOE/ET-14855/12) Avail: NTIS HC A03/MF A01

The mechanism of cleavage of key bond types precent in coals, and catalysis of conversion in CO-H2O systems are described. Catalytic carbon-carbon and carbon-oxygen bond cleavage in coal related diphenylmethane and diphenyl ether structures were measured. The homogeneous scission of carbon-oxygen bonds in diphenyl ether structure was also studied. The CO-H2O conversion level is obtained with aqueous solutions either at a starting pH above 12.6 or in neutral solutions with water soluble catalysts present. Catalysts, including the potassium or sodium salts of molybdate, chromate, manganate, and tungstate was studied and it is found that all are effective in the 3000 to 6000 ppM range. The nitrate was converted to ammonium ion and formate was detected in the product aqueous phase. It is found that catalytic quantities of sodium formate in CO/H2O at pH 7 are effective in the conversion. DOE

N82-15559# Los Alamos Scientific Lab., N. Mex.
HOT DRY ROCK GEOTHERMAL PROSPECTS, 1981
F. Goff, A. W. Laughlin, J. Aldrich, M. E. Ander, B. H. Amey, E. Decker, J. Gardner, G. Heiken, A. J. Kron, C. M. LaDelfe et al 1981 5 p refs Presented at the Geothermal Resources Council Ann. Meeting, Houston, Tex. 25-29 Oct. 1981
(Contract W-7405-eng-36)
(DE81-025305; LA-UR-81-1807; CONF-811015-8) Avail: NTIS HC A02/MF A01

Sites within the USA as candidates for development of a second hot dry rock (HDR) geothermal system were assessed. Potential sites examined fell broadly into three categories according to the nature of their thermal anomalies: (1) quaternary magmahydrothermal (volcanic or igneous) systems; (2) regional thermal anomalies of tectonic origin; and (3) prequaternary plutonic and metamorphic complexes. Sites with both electrical generation and direct use potential were considered however, efforts were concentrated on electrical sites. DOE

N82-15560# Pacific Northwest Lab., Richland, Wash.
WIND SPEED SIMULATION FOR ECONOMIC EVALUATION OF WIND ENERGY CONVERSION SYSTEMS
J. V. Ramsdell, G. F. Athey, and M. Y. Ballinger Jul. 1981 14 p refs Presented at the 4th U.S. Natl. Conf. of Wind Eng. Res., Seattle, 26-29 Jul. 1981 Submitted for publication
(Contract DE-AC06-76RL-01830)
(DE81-030077; PNL-SA-9149; CONF-810742-3) Avail: NTIS HC A02/MF A01

A time series model was developed for the simulation of wind speeds. The model provides for the incorporation of systematic seasonal variation of the mean speed, standard deviation, and correlation of speeds. It also provides for incorporation of the systematic diurnal variation of the mean speed and the standard deviation. As a demonstration of the model capabilities, a number of simulations were using model parameters derived from data previously collected. The results of analyses of both sets of data, the simulated set and the real data, were compared. In general the major features found in the analyses of the real data are identifiable in the corresponding analyses of the simulated data. The primary difference between the two data sets is in the frequency of high wind speeds. The frequencies of hourly and daily average wind speeds greater than two standard deviations above the mean are underestimated slightly by the model. DOE

N82-15583# TRW Energy Systems, Redondo Beach, Calif.
SAMPLING AND ANALYSIS OF POTENTIAL GEOTHERMAL SITES Final Report, Apr. 1978 - Apr. 1979
R. Sung, G. Houser, D. Strehler, and K. Scheyer Aug. 1981 206 p refs
(Contract EPA-68-03-2560)
(PB81-240061; EPA-600/7-81-138) Avail: NTIS HC A10/MF A01 CSCL 08I

Information on the physical, chemical and radiochemical data of geothermal manifestations (wells and springs) in areas with the most probable potential for development was documented. The information can be used to evaluate control technologies and to ultimately establish emission/discharge standards for the emerging geothermal industry. GRA

N82-15604# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
REAL-TIME COARSE-PARTICLE MASS MEASUREMENTS IN A HIGH-TEMPERATURE/PRESSURE COAL-GASIFIER PROCESS TREATMENT
J. Wegrzyn, J. Saunders, and W. Marlow 1981 7 p Presented at the Conf. on High Temp., High Pressure Particulate and Alkali Control in Coal Combust. Process Streams, Morgantown, W. Va., 3-5 Feb. 1981
(Contract DE-AC02-76CH-00016)
(DE81-030039; BNL-29953; CONF-810261-1) Avail: NTIS HC A02/MF A01

A sampling system that employs a probe appropriate for direct extracted sampling of erosive range particulate matter from a coal gasifier outlet or a high pressure fluidized bed combustor was constructed. The sampling system consists of four modules: (1) a null balance extractive probe with injection through a porous lined tube to minimize wall loss; (2) a stem type virtual impactor to separate coarse from fine particles; (3) a filter tape collector; and (4) a beta gauge total mass detector. A stem type virtual impactor separates at ambient gas stream conditions the coarse particles from the sampling stream so that at filtration no condensible vapors, fine particles or reactive gases pass through the filter tape. This system provides coarse particle mass flux data with a time resolution of 30 seconds or better. Sampling requirements for high temperature, high pressure aerosols are defined and discussed. DOE

N82-15656# Goettingen Univ. (West Germany). Inst. fuer Geophysik.
GEOMAGNETIC AND MAGNETOTELLURIC SOUNDINGS IN THE AREA OF THE CENTRAL EUROPEAN RIFT SYSTEM Final Report, Jun. 1980
Michael Lee Richards, Urich Schmucker, Erich Steveling, and Juergen Waterman Bonn Bundesministerum fuer Forschung und Technologie Aug. 1981 76 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie and EEC
(BMFT-FB-T-81-111; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 16

The conductivity structure connected with the Central European rift system was investigated with regard to geothermal energy sources using methods of geomagnetic depth sounding and magnetotelluric sounding. Sensors, a data acquisition system, and a software package for data handling and data analysis were developed. During a test campaign in the Leinegraben area and two field campaigns in the Rheingraben area, geoelectric and geomagnetic variations in the period range from 6 seconds to 24 hours were registrated. At base sites in the Rheingraben and the Black Forest, models of the vertical profile of the electrical conductivity were determined, while at sites in between the lateral conductivity variations were investigated. The perturbation of magnetic field in the region of the Rheingraben is strong and frequency dependent. The higher frequencies (low penetration depths) show the influence of the graben sedimentary structure, filling only the narrow graben area, and strong currents along the center of the graben. The lower frequencies (deeper penetration depths) reflect the deeper, probably broader conductivity structure. Author

N82-15661# Los Alamos Scientific Lab., N. Mex.
SCHLUMBERGER RESISTIVITY STUDY OF THE JEMEZ

SPRINGS REGION OF NORTHWESTERN NEW MEXICO
Chris Pearson and Fraser Goff 1981 5 p refs Presented at the Geothermal Resources Council Ann. Meeting, Houston, Tex., 25-29 Oct. 1981
(Contract W-7405-eng-36)
(DE81-025302; LA-UR-81-1806; CONF-811015-10) Avail: NTIS HC A02/MF A01

Schlumberger resistivity soundings made in the Jemez Mountains of northwestern New Mexico, near the village of Jemez Springs, are presented. Three areas that have potential as low temperature geothermal reservoirs were identified. The areas are characterized by a localized zone of very low resistivity which represents the extent of geothermal water and correlates with the location of hot springs or recent volcanic rocks. Resistivities increase rapidly toward the margins of the anomalies, suggesting either variable porosities or variable temperatures and salinities in the reservoirs.
DOE

N82-16991# California Univ., Berkeley. Lawrence Berkeley Lab. Engineering and Technical Services Div.
GRAD: A TOOL FOR PROGRAM ANALYSIS AND PROGRESS MONITORING
Winifred W. S. Yen and J. Dennis Lawrence Jun. 1981 5 p refs Presented at the Ann. Meeting of the Geothermal Resources Council, Houston, Tex., 25-29 Oct. 1981
(Contract W-7405-eng-48)
(DE81-028098; LBL-12820; CONF-811015-14) Avail: NTIS HC A02/MF A01

The development and operation of the Geothermal Resource Areas Database (GRAD) is described. The data base was created as part of the National Geothermal Progress Monitor System in 1979. The data base is organized around the concept of a geothermal area and provides broad coverage of geothermal development activities in the United States. Sixteen records, covering pre-lease, lease, and post-lease activities are defined for each area. Data collected in the various subject areas are critically evaluated, and then entered into an on-line interactive computer system. The system is publicly available for retrieval and use.
DOE

05
ENERGY CONVERSION

Includes photovoltaic, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors and magnetohydrodynamic generators.

A82-10192 Photoacoustic figure of merit for photothermal energy conversion efficiency. D. Cahen (Weizmann Institute of Science, Rehovot, Israel). *Optics Communications*, vol. 39, Oct. 15, 1981, p. 243-246. 15 refs.

The photoacoustic signal detected near the non-illuminated back surface of a photothermal converter can be used for comparative studies of the conversion efficiency of the converter. The signal is caused not only by the thermal wave transmitted through the sample, but also by mechanical vibrations of the sample itself. While no absolute absorptance or emittance values can be obtained, the signal reflects the influences of both these quantities on the conversion efficiency. Thus this kind of method may lend itself to quality control of such converters, although direct comparisons between absorbing surfaces on different substrates are still problematic. (Author)

A82-10450 Waves of energy. F. G. W. Smith and R. H. Charlier. *Sea Frontiers*, vol. 27, May-June 1981, p. 139-149.

Possible means for harnessing the energy contained in ocean waves are considered. Problems associated with the low-grade nature of wave energy and the rate at which wave crests approach are pointed out, and simple devices already in use for the supply of energy to bell buoys, whistle buoys and lighted buoys are noted. Attention is then given to wave energy conversion systems based on the focusing of waves onto a narrow ramp leading to a reservoir from which water is released to power a turbine generator; a slightly submerged circular shell which directs waves into its center cavity where waves act to turn a turbine (the Dam-Atoll); a long vertical pipe with an internal valve allowing water to move in an upward direction (the Isaacs wave-energy pump); a turbine located at the bottom of an open-topped pipe (the Masuda buoy); a completely submerged closed air chamber from which runs a large pipe open to the sea; a wave piston which acts by the compression of air to drive a turbine; a massive structure with upper and lower reservoirs (the Russel rectifier); and devices which consist of floating or submerged objects which transfer wave energy to pumps (the Salter duck and Cockerell raft.) It is concluded that although wave-powered generators are not likely to become competitive in the near future or provide more than a small portion of world demand, they may be found useful under special conditions. A.L.W.

A82-10958 # Correlation between results of zone method and experiment in radiative heat transfer. A. J. Sistino (Argonne National Laboratory, Argonne, IL). *American Society of Mechanical Engineers and American Institute of Chemical Engineers, National Heat Transfer Conference, 20th, Milwaukee, WI, Aug. 2-5, 1981, ASME Paper 81-HT-71*. 5 p. 13 refs. Members, $2.00; nonmembers, $4.00. Research supported by the U.S. Department of Energy.

The zone method is used to simulate the radiative and conductive heat transfer characteristics of an engineering test facility. The results obtained with the zone method are compared to those measured in the subject facility, and it is found that the theoretical and experimental results agree within five percent when the effective wall emissivity is taken to be 0.25. This effective wall emissivity is the product of the actual wall emissivity times the self-absorption factor of the radiation in the cool boundary layer. (Author)

A82-10978 # Application of orthotropic plate theory to windmill blade design. C. Rubin (Vanderbilt University, Nashville, TN). *ASME, Transactions, Journal of Mechanical Design*, vol. 103, Oct. 1981, p. 892-894. 5 refs.

The windmill blade is treated as a semi-infinite orthotropic wedge with free-free boundary conditions. A closed form solution for the deflections and stresses is obtained as a function of the loading. The loading may be quite general. Results for three different materials which are commonly used for windmill blades (aluminum, sitka spruce, and fiberglass) are obtained. Applications also include ribbed, corrugated, and layered structures. In addition, other types of boundary conditions may be used to obtain solutions to a wide variety of other orthotropic plate problems. (Author)

A82-11131 The tilting mode in field-reversed configurations. R. A. Clemente and J. L. Milovich (Comisión Nacional de Energía Atómica, División Fusión Nuclear, Buenos Aires, Argentina). *Physics Letters*, vol. 85A, Sept. 21, 1981, p. 148-150. 5 refs.

Analytical consideration is given to the problem of the stability of plasma equilibria in toroidal field-reversed configurations to the rotation of the symmetry axis inside the separatrix (the tilting mode). The energy principle is applied to an axisymmetric configuration of an ideal plasma in which the plasma reaches the separatrix in the form of a revolution ellipsoid, and for which the equilibrium is described by Hill's vortex solution to the poloidal flux function. Analytic growth rates for the tilting mode are obtained as a function of the elongation of the separatrix, and it is found that the prolate field-reversed configurations are unsteble to the tilting mode, while spherical configurations are neutrally stable and oblate configurations are stable. Results confirm the studies of Rosenbluth and Bussac (1979) on the MHD stability of the spheromak. A.L.W.

A82-11389 Net energy analysis of small wind energy conversion systems. B. N. Haack (Ball State University, Muncie, IN). *Applied Energy*, vol. 9, Nov. 1981, p. 193-200. 15 refs.

The net energy of a small wind electric conversion system is calculated and compared with the net energy of other electricity sources. Net energy is the amount of energy remaining for consumer use after deducting the energy required to find and upgrade the energy source and construct and maintain the electricity generating system. A 3 kW rated wind electric system for residential use is examined. The amount of energy obtained from this system is estimated by using a computer-operated simulation model which incorporates wind speeds, residential electricity demands and parameters from the generator, inverter and storage components. The net energy gain for this wind system is better than that of other systems with which it is compared. (Author)

A82-11701 Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volumes 1, 2 & 3. Conference sponsored by ACS, AIChE, AIAA, ANS, ASME, IEEE, and SAE. New York, American Society of Mechanical Engineers, 1981. Vol. 1, 1038 p.; vol. 2, 1072 p.; vol. 3, 533 p. Price of three volumes, members, $145.; nonmembers, $165.

Topics covered include advanced concept in energy conversion, advanced energy systems, and power systems for aircraft and spacecraft applications. Papers were presented on biomass, efficient building mechanical systems, efficient industrial systems, electrochemical energy conversion, and energy storage, in addition to fossil energy, geothermal power systems, and heat engines and technology applications. Studies on hydrogen, MHD power generation, nuclear power, photovoltaic and solar thermal systems, Sterling cycle engines and technology, thermionics and thermoelectric power generation, and wind power are provided. M.S.K.

A82-11702 # The economic implications of the exergy and thermal efficiencies of energy conversion systems. H. E. Khalifa (United Technologies Research Center, East Hartford, CT). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1.

New York, American Society of Mechanical Engineers, 1981, p. 3-8.

The paper examines the concepts of first-law (thermal) and second-law (exergy) efficiencies of power generation systems and the manner in which these efficiencies affect the economics of such systems. It is shown that, although the thermal efficiency may provide a preliminary indicator of the unit cost of the energy conversion equipment, it is generally a poor measure of the degree of success of the system in utilizing the input energy stream. It is also shown that the exergy efficiency, while not particularly suitable for

estimating the equipment cost, provides an excellent measure of the energy source utilization efficiency. A simple methodology is given for combining the two efficiencies to provide some preliminary indications of the optimum design conditions for Rankine cycle energy conversion systems intended for the utilization of low-to-moderate-temperature energy streams such as those produced from geothermal and waste energy sources. (Author)

A82-11720 # A hidden advantage of permanent magnet electrical generating systems. J. J. O'Neill (General Electric Co., Binghamton, NY). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 136-139. 7 refs. USAF-supported research.

The development of permanent magnet aircraft electrical generating systems heralds the beginning of a new era. This technique brings many advantages to the user in terms of size, weight and reliability. However, the most significant of these advantages is the extremely high efficiency which is characteristic of these systems. This paper examines the effect of the higher system efficiency on the user, specifically in the area of aircraft fuel consumption. Driven by rising fuel costs, engine and aircraft manufacturers are striving for more efficient performance to minimize life cycle costs. The results of a study which examines the effect of several permanent magnet ratings on different aircraft sizes are presented. (Author)

A82-11747 # Development of space reactor core heat pipes. K. L. Meier, H. E. Martinez, and J. E. Runyan (California, University, Los Alamos, NM). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 296-301. 6 refs.

The Space Power Advanced Reactor (SPAR) core heat pipes are being developed to transport 15 kW of power at 1400 K. A straight, 2-m-long, 15.9-mm-diam heat pipe was fabricated of low-carbon arc-cast molybdenum and filled with sodium as the working fluid. This nonconcetric, annular, screen-tube-wick pipe was tested successfully at 16.1 kW at 1310 K, at which point a boiling limit was encountered. Follow-on work has produced an as yet untested heat pipe which has its wick centered in the evaporator by spacer wires to alleviate the boiling limit problem. A dual artery wick heat pipe is being fabricated to further improve on the boiling limit and increase redundancy. Because the heat pipe must bend around the radiation shield of the SPAR reactor, a series of bending experiments was performed. Promising results were achieved by filling the pipe completely with sodium and bending at 365 K. The solid sodium acted as a soft mandrel, allowing the wick to bend 90 deg on a 180-mm radius with neither large compression buckles nor tension tears. (Author)

A82-11748 # Heat pipes for NEP spacecraft radiators. D. M. Ernst (Thermacore, Inc., Leola, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 302-306.

The evolution of the NEP spacecraft and radiator over the past two years is traced. Radiator to energy conversion system interface designs are presented, as are radiator designs and the development of specific heat pipe hardware. Laboratory test results of a 900 K sodium heat pipe demonstrate that difficult geometrical transitions can be accomplished with heat pipes with flexible arterial wicks. C.R.

A82-11749 # A compact, efficient thermoelectric module for a space reactor. G. Fly (California, University, Los Alamos, NM). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 307-312. 13 refs.

The thermoelectric module for the Space Reactor (SPAR) program is a compact annular unit that provides high heat fluxes with a minimum of heat losses. All interfaces are fully bonded to minimize extraneous temperature drops. In order to reduce stresses within the module, the thermoelectric material is circumferentially segmented and a radial stress relief member is provided. An enhanced silicon-germanium material allows high temperature operation and provides a high figure-of-merit. By using a titanium silicate sublimation coating, the hot junction temperature can be increased further. Thus, a module with reasonably high thermoelectric efficiency, high reliability, and low weight is produced. Since 66 of these thermoelectric ring modules comprise a generator, and 90 generators make up the SPAR conversion system, adequate redundancy is also provided. (Author)

A82-11752 # Engineering development testing of the GPHS-RTG converter. R. D. Cockfield (General Electric Co., Philadelphia, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 321-325.

The GPHS-RTG will provide electrical power for the Galileo orbiter and for the two spacecraft of the International Solar Polar Mission. The RTG weighs 122 lb and deliver power for the duration of a four and one-half year mission, providing approximately 285 watts at the beginning of the mission, declining to approximately 250 watts at the end of the mission. The GPHS-RTG consists of two primary assemblies: the General Purpose Heat Source, and the converter. This paper deals only with the converter, and highlights engineering tests that provide support for its design development. Among the tests discussed are those of material characterization, component testing, and converter assembly testing. Engineering development testing culminates in performance and environmental testing of an electrically-heated converter. (Author)

A82-11753 # Modular isotopic thermoelectric generator. A. Schock (Fairchild Space and Electronics Co., Germantown, MD). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1.

New York, American Society of Mechanical Engineers, 1981, p. 327-342. 14 refs.

A short history of the 10 Radioisotope Thermoelectric Generators (RTG) thus far flown in space, and design and fabrication of a new generation RTG for coupling with the General Purpose Heat Source is presented. The new RTG is modular and can be expanded in 24 W steps to whatever power levels are desired, requiring only modification of the cooling fin dimensions. Each module contains four Pu-238O2 fuel pellets and eight elements, and failure of any module requires only replacement of that unit, without disturbing the others. 5% GaP added to the SiGe thermoelectric material has lowered thermal conductivity and raised efficiency from 0.083 to 0.105; hot junctions are at 1000 C, cold at 300 C. Details of the module design and fabrication, the hot shoe, housing, fins, all components and assembly procedures are presented. The modules are designed for initial use on the Solar Polar mission and the Galileo probe, and it is noted that the iridium cladding around the heat source pellets will withstand a planetary crash without breaching. Each module weighs 59.87 lb, has a power density of 4.71 W/lb, and is designed for a seven year mission life. M.S.K.

A82-11755 * # Advances in space power research and technology at the National Aeronautics and Space Administration. J. P. Mullin, L. P. Randolph, W. R. Hudson, and J. H. Ambrus (NASA, Washington, DC). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 355-361.

Progress and plans in various areas of the NASA Space Power Program are discussed. Solar cell research is narrowed to GaAs, multibandgap, and thin Si cells for arrays in planar and concentrator configurations, with further work to increase cell efficiency, radiation hardness, develop flexible encapsulants, and reduce cost. Electrochemical research is concentrating on increasing energy and power density, cycle and wet stand life, reliability and cost reduction of batteries. Further development of the Ni-H2 battery and O2-H2 fuel cell to multihundred kW with a 5 year life and 30,000 cycles is noted. Basic research is ongoing for alkali metal anodes for high energy density secondary cells. Nuclear thermoelectric propulsion is being developed for outer planets exploration propulsion systems, using Si-Ge generators, and studies with rare earth chalcogenides and sulfides are mentioned. Power Systems Management seeks to harmonize increasing power supply levels with inner and outer

spacecraft environments, circuits, demands, and automatic monitoring. Concomitant development of bipolar transistors, an infrared rectenna, spacecraft charging measurement, and larger heat pipe transport capacity are noted. M.S.K.

A82-11756 # Nuclear electric power for space systems - Technology background and flight systems program. G. L. Bennett, J. J. Lombardo, and B. J. Rock (U.S. Department of Energy, Space and Terrestrial Systems Div., Washington, DC). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 362-368. 7 refs.

The paper discusses past and future uses of radioisotope thermoelectric generators (RTGs) and the dynamic isotope power system which was developed for power levels up to 2 kWe. Advantages of using space nuclear electric power are presented, and the five functional parts of a generalized nuclear-reactor space power plant are given. Radioisotope thermoelectric generators and the RTG flight system are also discussed. The compact size, light weight, and long life of nuclear powered generators enable the operation of sensing, analytical and communication systems of satellites and other communication systems for long periods of time. D.L.G.

A82-11777 # Recent progress on the development of the Dow hollow fiber sodium-sulfur battery. C. A. Levine (Dow Chemical Co., Walnut Creek, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 823-825.

Recent progress in understanding the chemical and electrochemical mechanisms taking place in the Dow sodium-sulfur cell is summarized. The cell is based on using Na ion-conducting glass as the electrolyte. The cell construction is based on thousands of hollow glass fibers in parallel, each filled with sodium and communicating to a common sodium reservoir. The fibers are immersed in the sulfur-sulfide liquid catholyte, and a metal foil adjacent to the fibers acts as the cathode. Research is being carried out on cell performance in lifetime and cell resistance. Some of the research being done on glass, cathode foil, impurities, and safety is presented. Two approaches that have been taken to prevent the internal temperature of the cell from rising above 600 C are described. The first employs a metering orifice to limit the sodium flow, even in the event of a massive failure of the tubesheet. The other uses a ceramic 'sponge' to contain the sodium. C.R.

A82-11783 * # The AGT101 technology - An automotive alternative. R. A. Rackley and K. A. Davis (Garrett Turbine Engine Co., Phoenix, AZ). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1403-1407. Contract No. DEN3-167.

The Advanced Gas Turbine Powertrain System Development Project is oriented at providing the United States automotive industry the technology base necessary to produce gas turbine powertrains for automotive applications that will have: (1) reduced fuel consumption, (2) the ability to use a variety of fuels, (3) low emissions, and (4) competitive cost/performance. The AGT101 powertrain being developed consists of a regenerated single-shaft gas turbine engine flat rated at 74.6 kW (100 hp) coupled to a split-differential gearbox and a Ford automatic overdrive production transmission. Performance predictions for the AGT101 powertrain represent a 59-percent improvement in mileage estimates over a 1985 conventionally-powered automobile for the combined federal driving cycle. (Author)

A82-11805 # Overview of DOE's large stationary Stirling engine development program. K. L. Uherka, R. E. Holtz (Argonne National Laboratory, Argonne, IL), and W. Bunker (U.S. Department of Energy, Washington, DC). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1847-1853. 8 refs.

This paper summarizes the results to date of a program, sponsored by DOE's Office of Fossil Energy, to develop large stationary Stirling engine power systems. Primary applications for such power plants include cogeneration and total energy systems, with a major advantage being their ability to employ solid coal and other non-scarce fuels in an environmentally acceptable manner. The major effort in the Stirling engine development program was an industry-based design competition, involving three independent contractual teams. Conceptual designs for state-of-the-art coal-fired Stirling engine systems were developed and all three design teams recommended development of 373 kW modules as base units, which can be coupled together to form individual Stirling engines up to 2238 kW in size. Heat transport system design concepts were also developed for integrating engine hot-end sections with coal combustors. (Author)

A82-11806 # Conceptual design of a large coal-fired stationary Stirling engine. M. Schuetz, J. Gerstmann (Advanced Mechanical Technology, Inc., Newton, MA), C. Bratt, J. Berntell (United Stirling AB, Malmo, Sweden), and D. Ernst (Thermacore, Inc., Leola, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1854-1859. 8 refs. Contract No. DE-AC02-79ET-15207.

A conceptual design is presented for a stationary coal-fired Stirling engine sized for power generation in the 400-2200 kW range, suitable for commercial/industrial cogeneration applications. The proposed power plant consists of one or more 500-hp Stirling engines, a coal combustion system and a heat transport system, along with an electric generator and waste heat recovery equipment of conventional design. The U-form engine is placed on top of a fluidized bed combustor, with the crankshaft above the cylinders and heater head, and heat is conveyed from the combustor to the engine heater-head by a two-stage sodium heat pipe. Projections of system performance for the case of an engine heater head temperature of 720 C, engine mean helium pressure of 15 MPa and engine speed of 900 rpm with waste heat utilization result in an overall efficiency of 79%. Based on a system capital cost of $950-1500/kW(e), an electric power generation cost of $0.093/kWh is estimated which may be reduced by waste heat utilization. A.L.W.

A82-11807 # Conceptual design of 500 to 3000 hp Stirling engines for stationary power generation. W. M. Toscano, R. Chandrasekhar, A. C. Harvey, and K. Lee (Foster-Miller Associates, Inc., Waltham, MA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1860-1865.

Both near term and far term conceptual designs of a 373 kW (500 hp) to 2237 kW (3000 hp) Stirling engine for stationary power generation have been prepared. The recommended near term conceptual design is modular, consisting of a basic Stirling engine cylinder of 100 kW that is easily adaptable to any type of heat input or machine output. The engine output configuration selected is the single crank, narrow V, multicylinder arrangement in which any number of cylinders, in groups of four or five, provide the desired power rating. For clean fuel combustion, the prevaporized, premixed, combustion method with exhaust gas recirculation is employed. For coal combustion a Wormser Grate two-stage atmospheric fluidized bed combustion system with a high pressure gas circulation loop system is recommended. The predicted overall fuel to electrical energy conversion efficiency varied between 25 and 34 percent, depending on the system configuration. (Author)

A82-11808 # Development free-piston Stirling test-bed engine. G. R. Dochat, N. G. Vitale, and T. M. Moynihan (Mechanical Technology Inc., Latham, NY). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1866-1874.

The free-piston Stirling Technology Demonstrator Engine (TDE) designed and instrumented to provide data to aid in understanding free-piston Stirling engine operation and performance, is described. It is noted that the system includes instrumentation to measure the internal thermodynamic operation and to permit calculation of system power flows. Near-term testing of the engine will assess three mechanisms for engine loss. It is pointed out that recent testing has demonstrated that the power and efficiency are strong functions of heater head temperature. A maximum power output of 1,800 watts

and a thermodynamic efficiency of 30% have been demonstrated at 450 C and 40 bar. C.R.

A82-11812 # Modelling of the jet-stream Fluidyne. G. T. Reader, G. Ivett, P. Gill (Royal Naval Engineering College, Plymouth, England), and P. D. Lewis (Delorean Motor Co., Northern Ireland). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1909-1915. 27 refs.

A summary of findings of a research program dealing with the Fluidyne, a liquid piston Stirling engine, is presented. The Fluidyne can operate in two modes: (1) 'wet', with a contiguous interface between the liquid piston and the working fluid; and (2) 'dry', in which the interface is sealed by a third fluid layer or mechanical float. Successful operation at temperatures below 550 K can only be achieved with a wet Fluidyne. Operation at only 80 deg C allows construction with unconventional heat engine materials such as plastics, glass and wood. The operational cycle of the Fluidyne is briefly described, and it is noted that the total system volume and relative volumes of the expansion, compression, and dead volumes do not remain constant, as they do in mechanical engines. A thermo-hydraulic model was therefore developed and results are listed, with further investigations still indicated for modelling the flows in the feedback zone, the relative contributions of the two superimposed thermodynamic cycles, and a modelling of the friction forces. M.S.K.

A82-11817 # High temperature cogeneration with thermionic burners. G. O. Fitzpatrick, E. J. Britt, and R. S. Dick (Rasor Associates, Inc., Sunnyvale, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1951-1955. 7 refs. Contract No. DE-AC02-76ET-11293.

The thermionic cogeneration combustor was conceived to meet industrial requirements for high-temperature direct heat, typically in the form of gas at temperatures from 800 to 1900 K, while at the same time supplying electricity. The thermionic combustor is entirely self-contained, with heat from the combustion region absorbed by the emitters of thermionic converters to be converted to electric power and the high-temperature reject heat from the converters used to preheat the air used for combustion. Depending on the temperature of the process gas produced, energy savings of around 10% with respect to that used to produce the same amount of electricity and heat without cogeneration are possible with present technology, and savings of up to 20% may be possible with advanced converters. Possible thermionic combustor designs currently under investigation include a configuration in which heat is collected by heat pipes lining the periphery of the combustion region, and a fire-tube converter in which combustion occurs within the cylindrical emitter of each converter. Preliminary component tests of these designs have been encouraging. A.L.W.

A82-11818 # Thermionic combustor application to combined gas and steam turbine power plants. G. Miskolczy, C. C. Wang, D. P. Lieb (Thermo Electron Corp., Waltham, MA), A. E. Margulies, L. J. Fusegni (Stone and Webster Engineering Corp., Boston, MA), and B. J. Lovell (Brown Boveri Turbomachinery, St. Cloud, MN). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1956-1961. 7 refs. Contract No. DE-AC02-76ET-11292.

A design for the insertion of thermionic converters into the wall of a conventional combustor to produce electricity in a topping cycle is described, and a study for applications in gas and steam generators of 70 and 30 MW is evaluated for engineering and economic feasibility. Waste heat from the thermionic elements is used to preheat the combustor air; the heat absorbed by the elements plus further quenching of the exhaust gases with ammonia is projected to reduce NO(x) emissions to acceptable levels. Schematics, flow diagrams, and components of a computer model for cost projections are provided. It was found that temperatures around the emitters must be maintained above 1,600 K, with maximum efficiency and allowable temperature at 1,800 K, while collectors generate maximally at 950 K, with a corresponding work function of 1.5 eV. Cost sensitive studies indicate an installed price of $475/kW for the topping cycle, with improvements in thermionic converter characteristics bringing the cost to $375/kW at a busbar figure of 500 mills/kWh. M.S.K.

A82-11820 # The design of series-parallel connected thermionic converter arrays. J. B. McVey, E. J. Britt, G. O. Fitzpatrick, and R. S. Dick (Rasor Associates, Inc., Sunnyvale, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1968-1973. 9 refs. Contract No. DE-AC02-76ET-11293.

Thermionic converters are connected together in a series-parallel array in order to provide a useful output voltage. A model is presented to predict the effects of a nonuniform distribution of input power on the performance of such an array. Three cases are considered: where (1) the heat flux is uniform; (2) the heat flux nonuniformity is in the direction of series connections in the array; (3) the heat flux nonuniformity is in the direction of parallel connections. The effect of optimizing cesium pressure for the individual converters is also studied. Results show that the heat flux variation in the series direction can cause a 20-40% drop in array output power as compared to a uniform heat input, as well as an unacceptable variation in emitter temperatures. Heat flux variation along the parallel connections without optimizing cesium pressure causes a 38% loss of array output power and very high emitter temperatures in some converters. Optimization of the cesium pressure in this case, however, reduces the output power loss to 12% and gives emitter temperatures which are all within an acceptable range. Thus, given a proper design, series-parallel arrays can be used to accommodate wide ranges of heat input while still delivering good performance. J.F.

A82-11821 # Characteristics of CVD silicon carbide thermionic converters. D. B. Goodale, P. Reagan, G. Miskolczy, D. Lieb, and F. N. Huffman (Thermo Electron Corp., Waltham, MA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1974-1978. 5 refs. Contract No. DE-AC02-76ET-11292.

Development work has recently been undertaken on a thermionic converter for terrestrial applications which employs chemically vapor deposited (CVD) silicon carbide as a protective coating over the CVD tungsten emitter. A 1-in.-diam hemispherical converter with an active emitting area of 6 sq cm has been constructed and has undergone over 7200 hours of life testing at an emitter temperature of 1730 K, collector temperature between 800 and 900 K and power output of 2 W/sq cm at 0.25 V. A module using four 1-in. hemispherical converters was built to investigate the problems of operating converter arrays, revealing the importance of minimizing interconnecting lead loss. A 2-in.-diam prototype converter was constructed which has so far accumulated over 1700 hours of life tests at emitter temperatures of 1600 to 1700 K in a natural gas fired furnace. As a result of problems with emitter-collector spacing and temperature nonuniformities discovered during testing, a new converter is being designed with a torispherical hot shell-emitter configuration. Composite hot shell-emitter structures have successfully undergone a series of severe thermal and mechanical tests under conditions exceeding any the shell would experience in application. Results indicate that combustion-heated thermionic converters can operate stably at high temperatures for long periods at interesting efficiencies and power densities. S.C.S.

A82-11822 # Thermionic application for future air force space power systems. T. Mahefkey (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1979-1981. 5 refs.

This paper reviews some of the potential requirements for future military space power systems and summarizes some of the potential advantages of nuclear power for these missions. A brief comparison of solar and nuclear power system performance is presented, and results of recent NASA/DOE/Air Force programmatic planning efforts are described. It is concluded that a high performance (50W/lb), high power (10-100 kW) technology program should be included as an integral part of current DOE and/or future joint agency sponsored space nuclear reactor program. (Author)

A82-11823 * # Advanced high temperature thermoelectrics for space power. A. Lockwood, R. Ewell (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and C. Wood (Northern Illinois University, Dekalb, IL). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 1985-1990. 7 refs.

Preliminary results from a spacecraft system study show that an optimum hot junction temperature is in the range of 1500 K for advanced nuclear reactor technology combined with thermoelectric conversion. Advanced silicon germanium thermoelectric conversion is feasible if hot junction temperatures can be raised roughly 100 C or if gallium phosphide can be used to improve the figure of merit, but the performance is marginal. Two new classes of refractory materials, rare earth sulfides and boron-carbon alloys, are being investigated to improve the specific weight of the generator system. Preliminary data on the sulfides have shown very high figures of merit over short temperature ranges. Both n- and p-type doping have been obtained. Pure boron-carbide may extrapolate to high figure of merit at temperatures well above 1500 K but not lower temperature; n-type conduction has been reported by others, but not yet observed in the JPL program. Inadvertant impurity doping may explain the divergence of results reported. (Author)

A82-11824 # Applications of thermoelectrics to geothermal energy conversion. T. S. Jayadev and D. J. Chou (Energy Conversion Devices, Inc., Troy, MI). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2004-2007.

The results of analytic studies of a geothermal power plant using thermoelectrics is presented, based on earlier studies of a thermoelectric OTEC system. The thermoelectric modules are sandwiched between the flow channels of a crossflow heat exchanger. All units were optimized for efficiency and net power was calculated considering all losses. A sensitivity analysis was performed to consider: (1) the rate of geothermal to cooling water flow rates; (2) enhancement factor of the heat transfer surface; (3) the figure of merit of the thermoelectric material; and (4) the multiplier factor of the total cost including fabrication. Enhanced surfaces were found to decrease the specific material cost due to increased heat transfer area. Installation costs were calculated to be $500/kW, compared to $2,000 to $3,000/kW for Organic Rankine Cycle Engines. Charts are presented of various cost factors, efficiency ratios, and power extraction ratios for a 24 C cooling water, 82 C geothermal fluid power plant. M.S.K.

A82-11825 * # Establishment of noise acceptance criteria for wind turbines. D. G. Stephens (NASA, Langley Research Center, Hampton, VA), K. P. Shepherd, and F. Grosveld (Bionetics Corp., Hampton, VA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2033-2036. 7 refs.

A program is being conducted to develop noise criteria for wind turbines which minimize annoyance and which can be used in design specifications for future machines. The approach consists of presenting wind turbine noise stimuli to test subjects in a laboratory listening chamber. The responses of the subjects are recorded for a range of stimuli which encompass the designs, operating conditions, and ambient noise levels of current and future installations. Results to date have established the threshold of detectability for a range of impulsive stimuli of the type associated with blade/tower-wake interactions. The status of the ongoing psychoacoustic tests, the subjective data, and the approach to the development of noise acceptance criteria are described. (Author)

A82-11826 # The effect of shielding on the aerodynamic performance of Savonius wind turbines. S. M. Morcos, M. G. Khalafallah (Cairo, University, Cairo, Egypt), and H. A. Heikel (Helwan University, Cairo, Egypt). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2037-2040. 7 refs.

The effect of the flat plate shield on the performance of two-bladed Savonius rotor has been experimentally determined. Tests were carried out in a low speed wind tunnel with a working section of 1.0 sq m. Flat plate shields with various values of plate width and inclination angle were tested in order to determine the optimum configuration. The maximum power coefficient of the Savonius rotor was increased from 0.22 for the case without shielding to 0.34 for the case with an optimum shielding configuration. The addition of a flat plate shield to the Savonius rotor can, therefore, enhance the power coefficient to values approaching the more elaborate wind turbines without affecting the simplicity of the Savonius rotor. (Author)

A82-11827 # Performance testing of a Savonius windmill rotor in shear flows. O. O. Mojola and O. E. Onasanya (Ife, University, Ile-Ife, Nigeria). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2041-2046. 8 refs.

The effects of flow shear and/or unsteadiness on the power producing performance of a Savonius windmill rotor are studied. Measurements are made in two laboratory statistically-steady shear flows, and in the natural wind, which is both viscous and unsteady. The measurements were made of the speed, torque, and power of the rotor at a number of streamwise stations for each of four values of the bucket overlap ratio. Flow velocity profiles and graphs of wind shear variation are given. It is concluded that even in the presence of shear, the power coefficient of a Savonius windmill rotor is most strongly dependent on the tip speed ratio. As in inviscid flow, the power coefficient peaked at a tip speed ratio = 0.8. The major effect of shear was to reduce the power coefficient below the inviscid flow level, the magnitude of reduction depending on the magnitude of shear present. In field testing of the Savonius rotor, the unsteadiness of the wind proved to be a greater source of power loss than the wind shear. J.F.

A82-11828 # An overview of fatigue failures at the Rocky Flats Wind System Test Center. C. A. Waldon (Rockwell International Corp., Golden, CO). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2047-2052.

Common mode structural failures discovered at the Rocky Flats Small Wind Energy Conversion System (WECS) Test Center are discussed. Each field tested system underwent at least one 80-125 mph wind storm, and a 40% failure rate is reported. Causes of fatigue failure were determined to be higher than expected loadings, vibrational loading excited within operational range (fundamental frequencies are equaled by operational frequencies), unsupported thin materials, stress risers caused by sharp edges and threads, poor quality assurance on fabrication, welding, and handling, and voids or cracks in cast parts (lack of X-rays). Numerous examples are listed for various wind systems. It is noted that although standard procedures are used for verifying individual components of a WECS, problems often occur when the individual parts are interfaced on a high speed machine in what is often a turbulent environment. Computer programs have been developed to aid in quality assurance testing, and can be used by manufacturers who cannot afford extensive testing procedures and apparatus. M.S.K.

A82-11829 # A vertical axis cyclogiro type wind-turbine with freely-hinged blades. D. A. Bayly and J. A. C. Kentfield (Calgary, University, Calgary, Alberta, Canada). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2053-2059. 13 refs. Research supported by the Algas Resources, Ltd.

A description is given of the design, construction and testing of a prototype vertical axis cycloturbine. The machine has straight vertical blades of symmetrical cross-section. Each blade is hinged, on a vertical axis, near its upper and lower extremities to the ends of radial arms projecting from a central, rotating, tower structure. What is believed to be a unique method is used for the control of blade articulation. The cyclic motion of each blade is derived solely from a combination of the centrifuging action of a mass attached to the blade and the aerodynamic load acting on the blade. Results of open-air tests of the small two-bladed prototype unit resulted in the achievement of a maximum power coefficient of 0.37 at a velocity

ratio of 3.8 with a runaway velocity ratio of 5.2. The machine was found to self-start easily. (Author)

A82-11831 # Design considerations for small wind energy conversion and storage systems. G. C. Chang (Cleveland State University, Cleveland, OH). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2070-2074. 6 refs.

A small wind turbine generator system capable of providing electricity to an all electric residence is considered. A host of major design considerations are examined. These include the characteristics of a wind turbine generator, the nature of the electric load demand, the available wind resources, siting considerations, and other related socioeconomic factors. The energy storage subsystem is singled out for detailed treatment because of its high cost and relative importance. Preliminary systems design for a 10-kilowatt wind turbine generator system with energy storage has been effected. Performance analysis of such a system has been done using actual hour-by-hour wind data for three specific sites. Results from these analyses are presented to illustrate the importance associated with major design considerations. (Author)

A82-11832 # Review of electrochemical energy conversion and storage for ocean thermal and wind energy systems. A. R. Landgrebe (U.S. Department of Energy, Washington, DC) and S. W. Donley (Aerospace Corp., Germantown, MD). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 2. New York, American Society of Mechanical Engineers, 1981, p. 2075-2080. 11 refs.

A literature review on electrochemical storage techniques related to ocean thermal (OTEC) and wind energy conversion systems (WECS) is presented. Battery use for WECS is foreseen because of siting size, variable capacity, quiet operation, and high efficiency; high cost and the necessity for further input voltage regulation is noted, as are prospects for technology transfer from existing programs for photovoltaic panel battery development. Fuel cells, which can run on hydrogen, ammonia, methanol, naphtha, etc., are encouraging because capacity increases are possible by simple addition of more fuel, and high thermal efficiency. Electrolytic use is seen as a cheap replacement source of electricity for metals refining and brine electrolysis. Systems of energy 'bridges' for OTEC plants, to transmit power to users, are reviewed as redox-flow, lithium-water-air, and aluminum batteries, fuel cells, electrolytic hydrogen, methane, and ammonia production, and the use of OTECs as power sources for floating factories. Directions of future research are indicated, noting that WECS will be in commercial production by 1985, while OTEC is far term, around 2025. M.S.K.

A82-11833 # Regenerative pyroelectric heat engine. R. B. Olsen and J. M. Briscoe (Power Conversion Technology, Inc., San Diego, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2081-2085. 12 refs. Research supported by the U.S. Department of Energy.

A single-stage regenerative pyroelectric heat engine has been built and tested. The pyroelectric engine converts heat directly into electrical energy. The efficiency of the conversion process was directly measured (the first such measurement for any pyroelectric conversion process). The measured 0.4% efficiency is 20 times larger than the so-called van der Ziel limit. Further improvements of efficiency are discussed. The engine's power density (at 0.13 Hz) was 17 Watt per liter of ferroelectric material. This early progress indicates that multi-staged pyroelectric engines operating at higher frequencies may achieve 2 kWe per liter with efficiencies of 10% to 20%. (Author)

A82-11840 # Nuclear reactor closed Brayton cycle space power conversion systems. J. P. Layton. In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2119-2121.

The history, status, and future prospects for use of nuclear reactor closed Brayton cycle (cBc) spacecraft power conversion systems is presented. It is noted that the only working nuclear space power system presently in existence is used for thermoelectric power conversion in the 10-100 kWe output. Many missions have been identified that would require high power reactors, including civilian and military communications platforms, operational space and lunar stations, power and microwave relay stations, and eventual solar system and interstellar exploration. Nuclear cBc reactors are considered well suited to requirements over 100 kW to a few MW. Noble gases (He and Ar) are circulated through heat exchangers to power electrical turbines, with all components in hermetically sealed casings and shafts rotating on hydrodynamic foil bearings. Development of new, long-life high temperature materials is considered necessary for cBc employment in space applications. An extensive design and software development program is recommended, to be compared on-line with progress of other systems being considered for the same missions. M.S.K.

A82-11852 # Brayton cycle using dissociating nitrosyl chloride. K. Kesavan (Westinghouse Electric Corp., Advanced Reactors Div., Madison, PA) and J. F. Osterle (Carnegie-Mellon University, Pittsburgh, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2204-2209. 13 refs.

A study of the Brayton cycle with dissociating nitrosyl chloride (NOCl) as the working medium is reported. With the turbine inlet conditions of the gas in a highly dissociated state (a mixture of NOCl, NO, and Cl2) and the compressor inlet at the combined state (NOCl), the dissociating NOCl cycle shows superior overall performance when compared with the Brayton cycle based on inert gases such as helium. The results of the analysis show considerable potential for reduction in power generation costs through higher cycle efficiencies and smaller component sizes. (Author)

A82-11853 # Advances in coal fired MHD generator research. J. K. Koester (Stanford University, Stanford, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2210-2213. 13 refs. Research supported by the Electric Power Research Institute.

The results of a decade of research on direct coal-fired magnetohydrodynamic generator systems is summarized. Channel operation with thin molten slag deposits benefited from the resulting thermal barrier at the expense of electrical problems due to the ionic conduction behavior of molten slag. Slag induced anode corrosion problems have been reduced by both cold arc-mode electrodes and by high temperature diffuse mode electrodes. Axial shorting induced by cathodic slag polarization has been suppressed by careful insulator/electrode design. The successful operation time of MHD generators under coal-fired conditions has increased from 1/2 hour to over 500 hours. (Author)

A82-11854 # Status report on MHD generator materials. B. R. Rossing and L. H. Cadoff (Westinghouse Electric Corp., Pittsburgh, PA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2214-2216. 12 refs.

The development of materials for the MHD generator has historically been cited as a major technical obstacle in the development of commercial coal-fired MHD electrical power generation. Serious effort has been in progress over the last five years to develop and test coal fired MHD electrodes and materials. Two main approaches have been taken; first, the operation of 'cold' electrode walls that are coated with a thin coal slag layer and, secondly, the operation of 'super-hot' electrode walls that operate above the dew point of the slag. Progress using both of these approaches to MHD generator design and operation will be reviewed. (Author)

A82-11857 # Semiconductor converters/inverters for photovoltaic power supply. P. Longrigg (Solar Energy Research Institute, Golden, CO). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2233-2238.

The two generic types of DC to AC inverters are discussed, considering inherent problems and prospects for solution. A current source converter uses reference current from the AC utility line to chop the DC into AC using four thyristors as switches. Difficulties exist in that DC current contains lagging quadrature currents and are harmonics rich. Solutions are indicated in the form of tuned filters for controlling harmonics and a static VAR generator for the quadrature demand, except that solving the quadrature problem reintroduces further harmonics. In the voltage-sourced converter, which performs much like a synchronous generator, harmonics are also present and can be eliminated with pulse-width modulation. However, at lower powers, switching accelerates beyond attainable switching speed levels. Finally, a current-fed, force commutated converter is described which commutates ahead of the AC voltage; it may need special filters or buffers in addition to harmonics filters. Further studies are recommended in areas of cost reductions, interface overvoltage protection, harmonics, source stability, safety and code requirements, and utility system protection, all pertinent to photovoltaic power conditioning. Circuitry diagrams and AC V-I graphs are provided. M.S.K.

A82-11859 # **Variable speed wind turbine control system.** E. Conley (Michigan State University, East Lansing, MI). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3.
New York, American Society of Mechanical Engineers, 1981, p. 2243-2247.

Variable speed wind turbine operation offers potential increased energy production if the turbine rotor is controlled to operate at constant blade tip speed to wind speed ratio. Two variable speed control systems are compared to a constant speed control system during field tests of a 5m Darrieus type wind turbine generator. Data indicates that a simple variable speed control scheme using wind rotor RPM as the single input signal can control the Darrieus test machine to operate at roughly constant blade tip to wind speed ratio and thus maximize energy production. (Author)

A82-12113 * # **Flow aerodynamics modeling of an MHD swirl combustor - Calculations and experimental verification.** A. K. Gupta, J. M. Beer, J. F. Louis (MIT, Cambridge, MA), A. A. Busnaina, and D. G. Lilley (Oklahoma State University, Stillwater, OK). In: Fluid mechanics of combustion systems; Proceedings of the Fluids Engineering Conference, Boulder, CO, June 22, 23, 1981.
New York, American Society of Mechanical Engineers, 1981, p. 179-189. 19 refs. Contract No. DE-AC01-79ET-15518; Grant No. NA63-74.

The paper describes a computer code for calculating the flow dynamics of a constant-density flow in the second-stage trumpet shaped nozzle section of a two-stage MHD swirl combustor for application to a disk generator. The primitive pressure-velocity variable, finite-difference computer code has been developed for the computation of inert nonreacting turbulent swirling flows in an axisymmetric MHD model swirl combustor. The method and program involve a staggered grid system for axial and radial velocities, and a line relaxation technique for the efficient solution of the equations. The code produces as output the flow field map of the nondimensional stream function, axial and swirl velocity. It was found that the best location for seed injection to obtain a uniform distribution at the combustor exit is in the central location for seed injected at the entrance to the second stage combustor. P.T.H.

A82-12666 **Ionization waves in an argon discharge in a longitudinal gas flow.** Iu. I. Grigorian, A. E. Martirosian, M. Novak, V. O. Papanian (Akademiia Nauk Armianskoi SSR, Institut Fizicheskikh Issledovanii, Yerevan, Armenian SSR), and M. Chvoika (Ceskoslovenska Akademie Ved, Fyzikalni Ustav, Prague, Czechoslovakia; Akademiia Nauk Armianskoi SSR, Institut Fizicheskikh Issledovanii, Yerevan, Armenian SSR). *(Fizika Plazmy,* vol. 6, Nov.-Dec. 1980, p. 1357-1360.) *Soviet Journal of Plasma Physics,* vol. 6, Nov.-Dec. 1980, p. 744-746. 18 refs. Translation.

An experimental study of the generation of ionization waves in a longitudinal gas flow with velocities of 0-30 m/s and pressures of 1-30 torr is reported; the study has reference to certain processes in gas lasers and MHD generators. It is shown that in a longitudinal stream of argon the phase velocity of ionization waves is not the simple sum of gas velocity and wave velocity in the gas at rest, but depends nonlinearly on the stream velocity. Standing ionization waves were found to appear when a zero phase velocity was obtained. Attention is given to the existence of a homogeneous positive column and regular and irregular self-excited ionization waves in relation to discharge current, pressure, and gas flow velocity. B.J.

A82-12897 **Increasing power and efficiency by dynamic suppression of ionization instability in a plasma.** A. P. Vinogradov and V. S. Filinov (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 19, Mar.-Apr. 1981, p. 399-406.) *High Temperature,* vol. 19, no. 2, Sept. 1981, p. 295-301. 10 refs. Translation.

The dynamic method for suppressing ionization instability is studied. The efficiency of MHD devices operating in the Faraday switching mode with developed ionization instability is compared with the efficiency of an MHD device operating under conditions of dynamic suppression of ionization instability. It is shown that when the external circuit parameters are suitably chosen, there is a gain in the electric and polytropic efficiency as well as in the power of an MHD device operating under conditions of dynamic suppression of ionization instability. The possible practical implementation of the dynamic method of ionization instability suppression with the aid of power semiconductor instruments is assessed. C.R.

A82-12938 **Evaluation of organic acids as fuel cell electrolytes.** J. Ahmad, T. H. Nguyen, and R. T. Foley (American University, Washington, DC). *Electrochemical Society, Journal,* vol. 128, Nov. 1981, p. 2257-2261. 9 refs. Grant No. DAAK70-77-C-0080.

The electrochemical behavior of methanesulfonic acid, ethanesulfonic acid, and sulfoacetic acid as fuel cell electrolytes was studied in a half-cell at various temperatures. The rate of the electro-oxidation of hydrogen at 115 C was very high in methanesulfonic acid. The rate of the electro-oxidation of propane in all three acids was low even at 135 C. Further, there is evidence for adsorption of these acids on the platinum electrode. It was concluded that anhydrous sulfonic acids are not good electrolytes; water solutions are required. Sulfonic acids containing unprotected carbon-hydrogen bonds are adsorbed on platinum and probably decompose during electrolysis. A completely substituted (fluorinated) sulfonic acid would be the preferred electrolyte. (Author)

A82-13847 † **Unconventional techniques of energy conversion (Netraditsionnye sposoby preobrazovaniia vidov energii).** Iu. S. Bortnikov, N. S. Lidorenko, G. F. Muchnik, S. V. Riabikov, and D. S. Strebkov. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport,* Sept.-Oct. 1981, p. 3-12. In Russian.

The current status and future prospects of various unconventional energy technologies are examined. Consideration is given to geothermal, wind, ocean, thermoelectric, and hydrogen-based systems. Optimal design strategies and production plans for such systems are briefly discussed. B.J.

A82-14007 # **Utility operating strategy and requirements for the wind power forecast.** W. Dub and H. Pape (Regensburg, Universität, Regensburg, West Germany). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2539.* 10 p. 10 refs.

The commitment of a generation system including wind energy conversion systems will be based on wind speed and wind power forecasts. Forecasts for time spans of equal length with the startup/shutdown times of conventional units will be of great importance. The paper discusses forecast horizons up to 3 hours and 6 hours respectively. In addition, the problem of getting good wind speed forecasts is investigated by fitting time series models to wind speed data. Finally, the impact of hypothetical perfect forecasts on the commitment of intermediate load units is demonstrated by means of the wind power variations within spans up to 3 hours. (Author)

A82-14011 # **Proposed 12.5 MWe shelf-mounted OTEC pilot plant for power, water and mariculture at St. Croix.** M. S. Jones, Jr. (Ebasco Services, Inc., Newport Beach, CA), P. E. Slattery (Ebasco Services, Inc., New York, NY), W. L. Green (J. Ray

McDermott and Co., Inc., New Orleans, LA), P. J. Bakstad (TRW, Inc., Redondo Beach, CA), and T. R. Blake (Virgin Islands Water and Power Authority, St. Thomas, VI). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2546.* 11 p. 14 refs.

The U.S. Virgin Islands has developed a plan to use OTEC to generate electricity and fresh water, and to supply nutrient rich deep seawater for land based mariculture and aquaculture facilities. Projects of this nature have the potential to ameliorate shortages of food, fresh water, and energy which limit the possibilities of improving life for inhabitants in many of the world's tropical islands. The project has been sized to produce 12.5 MW of electricity, up to 5 million gallons per day (MGD) of fresh water and 50 MGD of deep seawater. Its output would offset between 400,000 and 475,000 Bbl/yr of petroleum products derived from imported oil currently used to generate electricity and desalination. (Author)

A82-14012 # Alternative ocean energy products and hybrid geothermal-OTEC /GEOTEC/ plants. G. L. Dugger, D. Richards, F. C. Paddison, L. L. Perini, W. H. Avery (Johns Hopkins University, Laurel, MD), and P. J. Ritzcovan (U.S. Department of Energy, Div. of Ocean Energy Technology, Washington, DC). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2547.* 11 p. 20 refs. Research supported by the U.S. Department of Energy.

Products other than electricity from OTEC power plants are explored. Noting that the highest temperature gradients with the least seasonal variability are situated in tropical waters, it is suggested that portable products, such as NH3, liquid H2, methanol, and liquid hydrocarbon fuels, in addition to metals refining, are the most attractive applications of OTEC power. Cost estimates are provided for each product based on an average annual temperature change of 23.9 C and a 325 MWe OTEC; the eighth plant costs are projected at $1,200/kW. Slowly cruising platforms for OTEC systems will have higher annual average temperature gradients than moored plants, and seasonal variations will relegate the monetary value of some OTEC electricity to fuel avoidance costs, due to lower winter gradient differences. Geothermal OTEC plants' performance is examined and found to exceed the normal OTEC efficiency by 12%. D.H.K.

A82-14016 # Cost estimates for advanced/innovative wind energy conversion systems /AWECS/. E. W. Jacobs (Solar Energy Research Institute, Golden, CO). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2557.* 5 p. 7 refs.

Three computer models for determining the economics of advanced wind energy conversion systems (AWECS) in production status are discussed. The SAMICS program, designed for estimating costs of production-line operations, includes details of expenses for a plant in steady-state operation, and yields results in terms of prices, quantities, and a breakdown of cost components. The PRICE model gives cost estimates for electromechanical hardware systems, and comprises design, manufacturing, and subassembly costs. The FAST program derives costs of energy systems in terms of construction and installation. All three models provide production costing, and it is noted that the FAST model can be used as an adjunct to the other two. Small WECS are viewed to become commercially viable at the 10,000 units/yr production level, using a one product job shop mode. Examples for existing 40 kW and 10 kW preproduction model SWECS are provided and a price lowering curve is generated which is similar to a learning curve. M.S.K.

A82-14017 # A modular simulation model for a wind turbine system. S. Bergman (Sydkraft AB, Malmo, Sweden), S. E. Mattsson, and A. B. Ostberg (Lund Institute of Technology, Lund, Sweden). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2558.* 9 p. 9 refs.

A mathematical simulation model for a large horizontal axis wind turbine system is presented. The model is intended for simulation of the synchronization of the wind turbine generator against the utility grid and the operation of the wind turbine system under different wind conditions and with different control algorithms. Particular attention has been given to the modularization. The model is divided into subsystems to make it easy to modify the model and adapt it to systems of similar type. The interactive simulation package SIMNON which allows good structuring and programming in a high level language has been used. (Author)

A82-14018 # Wind turbine assisted diesel generator systems. L. A. Schienbein (DAF Indal, Ltd., Mississauga, Ontario, Canada). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2559.* 8 p.

The need to reduce the cost of energy in remote communities served by diesel generators has led to the investigation of the use of wind energy to replace some or all of the fuel consumed. The development of wind-turbine-assisted diesel generators in Canada has progressed from the design and testing of a 12-kW unit to the design of a prototype 100-kW wind turbine diesel hybrid. This paper presents the results of the 12-kW tests and the implementation of the test results, and the results of further engineering and cost analyses in the design of a prototype 100-kW wind turbine diesel hybrid system. The value of wind energy in a wind turbine diesel hybrid is greatly improved if the diesel generator system itself is designed to operate more efficiently at part load, with or without wind power assistance. Excess wind energy and wind turbine power fluctuations (which result in voltage and frequency fluctuations) can be minimized by selecting the best rotor operating speed. (Author)

A82-14019 # Methodology for the evaluation of aerodynamic performance and rotor optimization under constant RPM-operation. F. Luft and D. Cromack (Massachusetts, University, Amherst, MA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2560.* 6 p.

Presented are a method for evaluating the aerodynamic performance of wind turbine rotors during constant RPM (varying tip-speed-ratio) operation and a summary of the results of a parametric study for optimization of the rotor using this method. The proper choice of rotor RPM is discussed as well as the comprehensive method for evaluating the power coefficient versus tip-speed-ratio curves for various rotors. The power coefficient vs tip-speed-ratio curve for any rotor is combined with wind velocity probability data in a manner which yields a monthly productivity value. A summary of the results of the parametric performance study of linear-taper linear-twist blades is presented, including the shape of the blade yielding the maximum productivity along with a sensitivity analysis. (Author)

A82-14020 # Proposed 10 MWe OTEC pilot plant for the Commonwealth of the Northern Mariana Islands. L. E. Dunbar (ADVANTECH Corp., La Jolla, CA) and G. L. Chan. *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2561.* 9 p. 8 refs.

A preliminary conceptual design of a 10 MWe OTEC pilot plant has been proposed for the island of Saipan in the Commonwealth of the Northern Mariana Islands. This unique small OTEC plant is intended as a prototype for commercial plants in the small Pacific Island territories and nations. The system concept minimizes local construction to accommodate a lack of local skilled labor and facilities. The baseline design is a concrete barge-mounted plant built in Portland, Oregon, towed to Saipan, and permanently anchored in near-shore shallow water. Details of key subsystem design features are provided including a bottom-mounted cold water pipe, modular power subsystem, and wave shield for storm protection. The results of economic analyses are presented to illustrate the cost competitiveness of electricity from the OTEC plant compared to the current oil-fired diesel units in Saipan. (Author)

A82-14025 # The transformation of wind energy by a high altitude power plant /HAPP/. G. Riegler, W. Riedler, and E. Horvath (Graz, Technische Universität, Graz, Austria). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2568.* 8 p. 9 refs.

Design considerations for a high altitude power plant (HAPP) are discussed. A HAPP has a generator platform supported by a balloon, a tethering and conduction cable, and a ground station for control and energy distribution. Each streamlined balloon would

carry six symmetrically arranged wind turbines and could be raised or lowered by a ground winch in response to 4 hr meteorological forecasts. A double bladed, variable pitch, horizontal axis rotor was chosen for HAPP application in the jet stream at 8,000-10,000 m height. Humidity and icing are calculated to be within tolerable limits; higher winter and lower summer heights are indicated. Optimization studies for 2, 5, and 7 MW turbines are presented, and rotor diameters are found to be limited to 40 m for weight considerations. Pilot plant, production, and operating costs are estimated to result in a cost of energy of $0.093/kWh, with the He leakage being the biggest expense. M.S.K.

A82-14026 # The stability of a tethered gyromill. D. C. Rye, B. W. Roberts (Sydney, University, Sydney, Australia), and J. Blackler. *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2569.* 10 p. 6 refs.

It has been proposed that electricity could be generated from upper atmospheric winds using a tethered rotary winged craft known as a gyromill. The paper investigates the static and dynamic stability of such a craft when hovering at limited altitudes. Two static stability criteria are presented, one pertaining to short cables, and another to longer cables. A mathematical model is developed to examine the dynamic behavior and several numerical solutions presented. Two modes are identified; a pitch mode and a pendular mode. It is found that the pendular mode may be divergent or non-divergent, depending on the cable attachment point. (Author)

A82-14027 # Rotor speed control by automatic yawing of two-bladed wind turbines with passive cyclic pitch variation. K. H. Hohenemser and A. H. P. Swift (Washington University, St. Louis, MO). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2570.* 8 p. 9 refs. Research sponsored by the Solar Energy Research Institute.

A yaw dynamics analysis was developed for a two-bladed horizontal axis wind turbine with passive cyclic pitch variation achieved by letting the blade pair freely oscillate about a common axis with which the blades formed a small prelag angle. This type of rotor was found capable of high yaw rates without imposing vibratory hub moments and without producing noticeable flapping amplitudes. Experiments were conducted with a tail vane stabilized 7.6 m diameter wind rotor driving a three phase alternator tuned and loaded to produce a rotor torque proportional to the square of the rotor speed. Two yaw control systems which replaced the usual blade feathering controls were investigated: an active yaw control system using a hydraulic rotor speed governor, and a passive system responding to a combination of rotor thrust and torque. Both systems limited during strong gusts rotor speed quite accurately. The passive system appeared to be more promising because of its greater reliability and because of the greater ease of adapting it to larger size wind turbines. (Author)

A82-14028 # Lightning protection for wind turbine electronics. D. L. Begley, C. W. Dodd, and T. M. McCalla, Jr. (Southern Illinois University, Carbondale, IL). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2571.* 6 p. 5 refs.

Preventive measures for the protection of wind turbines from lightning strike damage are outlined. Lightning can dissipate up to a billion joules in less than a second while electronic components have tolerances in the microjoule range. Structural members may also suffer damage by mechanical stresses due to parallel conductance of lightning amperage; millions of volts are capable of causing flashovers or ionized arcing through air or poor insulation. Studies are cited to indicate that semiconductor device failures are dependent on pulse duration and amplitude. A solution is offered in the form of lightning ground rods, counterpoises, and interconnections which route lightning strike currents away from all electronics; additional shielding of the central electronics is also suggested. Various layers of protective measures are diagrammed, and the use of a transient suppressor to short excess current to ground is recommended. D.H.K.

A82-14029 # An aeroelastic analysis of the Darrieus wind turbine. E. E. Meyer (Boeing Commercial Airplane Co., Seattle, WA) and C. E. Smith (Oregon State University, Corvallis, OR). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2572.* 12 p. 18 refs.

The stability of a single Darrieus wind turbine blade spinning in still air is investigated using linearized equations of motion. The three most dangerous flutter modes are characterized for a one-parameter family of blades. In addition, the influence of blade density, mass and aerodynamic center offsets, and structural damping is presented. (Author)

A82-14030 # Assessment of MHD power plants with coal gasification. M. R. DeLallo, Jr., R. E. Weinstein, J. C. Cutting, and W. R. Owens (Gilbert/Commonwealth, Reading, PA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2574.* 6 p. 5 refs. Contract No. DE-AC01-77ET-11058.

An assessment of the operational characteristics and cost of magnetohydrodynamic (MHD) power plants integrated with coal gasification was performed. The coal gasifier produces a slag and sulfur free fuel for the MHD combustor. This clean fuel eliminates slag and sulfur interactions with the MHD topping cycle and simplifies the design of the combustor, the MHD channel, and the heat and seed recovery (HRSR) subsystem components. This may increase MHD and HRSR system reliability and provide the potential for earlier commercial demonstration of MHD. Integration techniques with three advanced medium BTU gasifiers were evaluated and an optimum system defined. A detailed comparison was then performed with a direct coal fired MHD power plant using oxygen enrichment. Results indicate that incorporating a coal gasification process with MHD simplifies system design at the expense of lower overall net plant efficiency and higher levelized cost of electricity. (Author)

A82-14031 # Up- and down-wind rotor half interference model for VAWT. H. McCoy and J. L. Loth (West Virginia University, Morgantown, WV). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2579.* 9 p. 12 refs. Contract No. DE-FG02-80CS-89001.

This paper presents a theoretical aerodynamic performance optimization for two dimensional vertical axis wind turbines. A momentum type wake model is introduced with separate cosine type interference coefficients for the up and downwind half of the rotor. The cosine type loading permits the rotor blades to become unloaded near the junction of the upwind and downwind rotor halves. Both the optimum and the off design magnitude of the interference coefficients are obtained by equating the drag on each of the rotor halves to that on each of two cosine loaded actuator discs in series. The values for the optimum rotor efficiency, solidity and corresponding interference coefficients have been obtained in a closed form analytic solution by maximizing the power extracted from the downwind rotor half as well as from the entire rotor. A numerical solution was required when viscous effects were incorporated in the rotor optimization. (Author)

A82-14032 # A design for an MHD power plant as a prime mover for a Naval Vessel. M. A. Paluszek (Charles Stark Draper Laboratory, Inc., Cambridge, MA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2575.* 11 p. 21 refs. NSF Grant No. 22733.

A Magnetohydrodynamic Power Plant, designed to be the prime mover for a Naval Vessel, is presented. The system is an open cycle, fossil fueled, subsonic MHD Faraday generator with directly fired air preheaters. A superconducting electric transmission drives the propellers and a standard naval steam plant is used as a bottoming cycle. The increased overall efficiency achievable with this plant allows a lighter, smaller volume ship to accommodate the same payload and reduces the overall fuel cost of the vessel. (Author)

A82-14033 # Wind ripple analysis. R. E. Akins (Sandia National Laboratory, Albuquerque, NM). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2580.* 8 p. 6 refs. Contract No. DE-AC04-76DP-00789.

Efficient and economical utilization of wind power will require

the ability to measure and ultimately predict the effects fluctuations in the incident wind will have on a wind turbine. In order to quantitatively assess these effects, experimental techniques have been developed which allow analysis of full-scale performance of wind turbines with particular emphasis on the effects caused by turbulence in the incident wind. Examples of these techniques are presented using data from the DOE/Sandia Vertical Axis Wind Turbine (VAWT) program. (Author)

A82-14034 # Aerodynamic loads and rotor performance for the Darrieus wind turbines. I. Paraschivoiu (Hydro-Québec, Institut de Recherche, Varennes, Canada). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2582.* 10 p. 13 refs.

Aerodynamic blade loads and rotor performance are studied for the Darrieus windmill by using a double-multiple streamtube model. The Darrieus is represented as a pair of actuator disks in tandem at each level of the rotor, with upstream and downstream half-cycles. An equilibrium velocity exists in the center plane, and the upwind velocity is higher than the downwind velocity; lift and drag coefficients are calculated from the Reynolds number and the local angle of attack. Half-rotor torque and power are found by averaging the contributions from each streamtube at each position of the rotor in the upwind cycle. An example is provided for a 17 m Darrieus employing NACA blades. While the method is found to be suitable for predicting blade and rotor performance, the need to incorporate the effects of dynamic stall in the model is stressed as a means to improve accuracy. D.H.K.

A82-14036 # Problems and potential for MHD retrofit of existing coal-fired plants. G. Berry, C. Dennis, T. Johnson, V. Minkov, V. Pearson, and M. Petrick (Argonne National Laboratory, Argonne, IL). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2586.* 10 p. 5 refs.

Retrofitting existing power plants with an open-cycle MHD system has been re-examined in light of recent developments in the heat and seed recovery technology area. A new retrofit cycle configuration has been developed which provides for a direct gas-gas coupling; also, the MHD topping cycle can be decoupled from the existing plant for either separate or joint operation. The retrofit concept has been applied to Vermilion Station No. 1, a coal-fired power plant presently in operation. Substantial increases in efficiency have been demonstrated and the economic validity of the MHD retrofit approach has been established. (Author)

A82-14037 # Industrial applications of MHD high temperature air heater technology. D. P. Saari, J. E. Fenstermacher, L. R. White, and C. L. Marksberry (Fluidyne Engineering Corp., Minneapolis, MN). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2588.* 11 p. 39 refs. Contract No. DE-AC01-80ET-15602.

The MHD high temperature air heater (HTAH) requires technology beyond the current state-of-the-art of industrial regenerative heaters. Specific aspects of HTAH technology which may find other application include refractory materials and valves resistant to the high temperature, corrosive, slag-bearing gas, materials resistant to cyclic thermal stresses, high temperature support structures for the cored brick bed, regenerative heater operating techniques for preventing accumulation of slag in the heater, and analytical tools for computing regenerative heater size, cost, and performance. Areas where HTAH technology may find application include acetylene/ethylene production processes, flash pyrolysis of coal, high temperature gas reactors, coal gasification processes, various metallurgical processes, waste incineration, and improvements to existing regenerator technology such as blast furnace stoves and glass tank regenerators. (Author)

A82-14038 # OTEC ocean system development. D. Hove (Dynamics Technology, Inc., El Segundo, CA) and T. McGuinness (NOAA, OTEC Program Management Office, Rockville, MD). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2590.* 8 p. 17 refs.

Ocean systems embodied in OTEC floating power plant designs include features beyond present offshore practice. Design aspects of the platform, cold water pipe and mooring systems have been investigated in Government sponsored research programs to establish a technology base for commercial plant development. Recent laboratory tests have provided validation of concepts and design tools, and future programs will include large scale demonstration tests. (Author)

A82-14356 A review of rain erosion problems for aerogenerators. A. R. Mortimer (Science Research Council, Rutherford and Appleton Laboratories, Chilton, Oxon, England). *Wind Engineering*, vol. 5, no. 3, 1981, p. 136-146. 27 refs.

Erosive mechanisms and protective measures available for wind-powered generators exposed to rain are examined. Rain erosion is modeled in two stages: an incubation phase, when plastic deformation and crack formation occur with no loss of weight; and a phase of actual material loss. Raindrop impact causes a progressive tearing action, which is significant in the erosion of soft, compliant elastomers; light rain over a long time period is noted to cause fatigue. Choosing a protective surface necessitates consideration of both surface impact and the effects on the substrate. Metal, polymeric, and composite coatings are discussed, and it is found that softness reduces impact damage, and fine weaves in composites enhances stress concentration corrosion resistance. Continued studies specifically dealing with wind turbine blades are recommended, as current knowledge is derived from existing helicopter and propeller driven airplane data. D.H.K.

A82-14357 A first order mathematical model of the lift/drag characteristics of aerofoil sections. G. W.-W. Pontin (Wasco Windmills, Ltd., England). *Wind Engineering*, vol. 5, no. 3, 1981, p. 147-153.

The mathematical model described is believed to represent the lift/drag characteristics of commonly used airfoil sections with an accuracy sufficient for the purpose of wind turbine design. In this model an airfoil profile is characterized by six constants and the effects of roughness and Reynolds number by a further three correction factors in a form suitable for compact digital computer storage and manipulation. (Author)

A82-14358 Wind energy for the Federal Republic of Germany. L. Jarass, L. Hoffmann, G. Obermair (Regensburg Universität, Regensburg, West Germany), and A. Jarass (Forschungsgesellschaft für alternative Technologien und Wirtschaftsanalysen mbH, Regensburg, West Germany). *Wind Engineering*, vol. 5, no. 3, 1981, p. 154-161.

An evaluation of parameters affecting the operation of large windpowered turbines in conjunction with the electric grid of West Germany is presented. North Sea coastal areas were found to have winds with a 6-7.5 m/sec average at 10-40 m; a lack of a predominant wind direction implies that generator spacing will be uniform in all directions. The 100 m GROWIAN wind turbine is considered as the prototype machine, and will produce an optimum of 3 MW, operating in a range of 5-24 m/sec, with nominal output at about 13 m/sec. Sensitivity studies are outlined for varying levels of coastal and national grid penetration, showing a saturation of the coastal grid would occur with fifteen 300 MW windfarms. Economic analyses indicate that large scale wind electric production is now competitive with conventional central-generating plants, while wind energy storage is economical only if storage stays below 1 kW storage for every kW installed. D.H.K.

A82-14359 Energy transfer in wind-assist electric power systems. E. H. Gilmore (West Texas State University, Canyon, TX). *Wind Engineering*, vol. 5, no. 3, 1981, p. 162-174. 12 refs. Research supported by the U.S. Department of Agriculture.

A model is developed for describing mechanical wind-assist electric power systems operating under steady-state conditions. Representations for operating characteristics of system components are combined with the constraints assumed for the system to produce this model. Descriptions are in the form of torque, rpm pairs for the rotor. Analytic solution methods are discussed and a graphical solution procedure is illustrated. Applications in the areas of design and analysis of systems are considered, and the results of one series of tests on one wind-assist system are considered in terms of model parameters. (Author)

A82-14360 **An analytic model of high solidity vertical axis windmills.** R. G. Carothers and G. M. Bragg (Waterloo, University, Waterloo, Ontario, Canada). *Wind Engineering*, vol. 5, no. 3, 1981, p. 175-190. 8 refs.

By introducing an induced cross flow to the conventional flow models used for vertical-axis windmills an analytic model for high solidity rotors is developed. Results as predicted by the model are compared with those determined from wind tunnel tests. (Author)

A82-14489 **On the efficiency of thermal engines with power output - Harmonically driven engines.** V. Fairén (Stanford University, Stanford, CA; Madrid, Universidad Complutense, Madrid, Spain) and J. Ross (Stanford University, Stanford, CA). *Journal of Chemical Physics*, vol. 75, Dec. 1, 1981, p. 5490-5496. 11 refs. Research supported by the U.S. Department of Energy.

In a previous article a model of a heat engine was defined and studied with the purpose of emphasizing the role of inertial effects, particularly their importance in relation to optimization problems. Here the performance of models of heat engines harmonically driven around a state of equilibrium is compared. For the first model, with inertia, the model is defined, its nonlinear response with emphasis on the linear approximation is calculated, and the issues related to the coupling of the thermal and mechanical driving forces are discussed. The influence of increasing values of the mechanical friction coefficient is studied, and it is shown that when this coefficient is small, the work output displays subharmonic resonances that disappear when the friction coefficient increases. In the second model, without inertial effects, no such resonances appear as expected, since these are due only to the inertial terms. (Author)

A82-14844 # **A numerical model for the flow within the tower of a tornado-type wind energy system.** S. S. Ayad (Solar Energy Research Institute, Golden, CO). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Nov. 1981, p. 299-305. 11 refs. Contract No. EG-77-C-01-4042.

The optimum performance of a model tornado-type wind energy system is predicted based on the pressure distribution in a tower with a simulated turbine flow. A two equation turbulence model is used to fix the mean pressure values and the three components of wind velocity; consideration is given to different tower geometries and turbine exit flow conditions. The flow is assumed to be incompressible and axisymmetric, and a numerical solution is obtained by employing a finite difference method with a leapfrog scheme on a staggered mesh, with an iterative technique to account for the pressure gradient. A maximum power of 35% of a closed bottom tower was found at a turbine/tower diameter ratio of 0.5. Wind tunnel tests with a scale model agreed well with the predictions. D.H.K.

A82-14845 # **One viewpoint concerning unit size in the development of wind turbines.** W. E. Howell and C. J. Todd (U.S. Bureau of Reclamation, Office of Atmospheric Resources Research, Denver, CO). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 103, Nov. 1981, p. 306-312. 18 refs.

The effects of the size of windpowered generators on the growth of windpower utilization are considered. Noting that previous models have shown that the cost of electricity is negatively correlated with machine size, it is asserted that actual production experience will introduce additional benefits. The study was based on analyses using NASA supplied wind speed frequency distributions, and considers a range of 12-1200 GW of installed capacity at 8 and 10.7 m/sec windspeeds. Experience rates of 95, 90, and 85% were selected and calculations made for the first 0.3, 0.9, 1.2, and 2.4 MW machines of production runs. Highest experience rates favored a 0.6 MW size, and solutions to spacing requirements in windfarms to avoid the effects of wake turbulence are shown to be most economically achieved with machines in the 0.5 MW range. It is concluded that emphasis on medium size wind turbines, 0.3-0.6 MW, presents the least risk and greatest flexibility for rapid development of economically feasible windpower. D.H.K.

A82-15060 **Carbonate fuel cell power plant systems.** R. M. Reinstrom (General Electric Co., Energy Systems Programs Dept., Schenectady, NY). *(Institute of Electrical and Electronics Engineers, Summer Meeting, Portland, OR, July 26-31, 1981.) IEEE Transaction on Power Apparatus and Systems*, vol. PAS-100, Dec. 1981, p. 4752-4759. 11 refs. Research sponsored by the U.S. Department of Energy.

Carbonate fuel cells are an attractive means of developing highly efficient power plants capable of achieving low atmospheric emissions. Because carbonate fuel cells can be used with coal derived fuel gases and their operating temperatures allow the use of turbomachinery bottoming cycles, they are well suited for large installations (like central utility stations. Presently, system development activity is directed toward evaluating the readiness of gasifier and fuel processor technology, defining candidate cycle configurations, and calculating projected plant efficiencies. (Author)

A82-15070 **The electric utility 4.5 MW fuel cell power plant - An urban demonstration.** R. A. Bell and R. B. Hayman (Consolidated Edison Company of New York Inc., New York, NY). *(Institute of Electrical and Electronics Engineers, Summer Meeting, Portland, OR, July 26-31, 1981.) IEEE Transactions on Power Apparatus and Systems*, vol. PAS-100, Dec. 1981, p. 4760-4764.

The fuel cell could offer an attractive power generation option for electric utilities. This paper reviews the electric utilities' efforts to develop this technology including the siting and construction of the 4.5 MW phosphoric-acid fuel cell demonstrator in New York City. The paper concludes that the fuel cell is moving from technology demonstration status toward commercial service in electric utility systems during this decade. (Author)

A82-15071 **Potential dynamic impacts of wind turbines on utility systems.** H. W. Zaininger and D. J. Bell (Zaininger Engineering Co., San Jose, CA). *(Institute of Electrical and Electronics Engineers, Summer Meeting, Portland, OR, July 26-31, 1981.) IEEE Transaction on Power Apparatus and Systems*, vol. PAS-100, DEC. 1981, p. 4821-4829. 11 refs. Research sponsored by the Electric Power Research Institute.

This paper presents the results of an initial assessment of potential wind power generation dynamic impacts on utility systems from a global utility perspective performed for the Electric Power Research Institute. Dynamic study of minute-to-minute ramping, frequency excursions, and short-term transient stability was performed using the isolated Hawaiian Electric Company (HECO) system as an illustrative example. Potential minute-to-minute ramping requirements imposed on conventional generation units of two interconnected utilities, Kansas Gas and Electric (KG&E) and Public Service Company of Colorado (PSCo) were investigated, using interconnected utility operating criteria. (Author)

A82-15650 **Wind-energy recovery by a static Scherbius induction generator.** G. A. Smith and K. A. Nigim (Leicester, University, Leicester, England). *IEEE Proceedings, Part C - Generation, Transmission and Distribution*, vol. 128, pt. C, no. 6, Nov. 1981, p. 317-324. 9 refs.

The paper describes a technique for controlling a doubly fed induction generator driven by a windmill, or other form of variable-speed prime mover, to provide power generation into the national grid system. The secondary circuit of the generator is supplied at a variable frequency from a current source inverter which for test purposes is rated to allow energy recovery, from a simulated windmill, from maximum speed to standstill. To overcome the stability problems normally associated with doubly fed machines a novel signal generator, which is locked in phase with the rotor EMF, controls the secondary power to provide operation over a wide range of subsynchronous and supersynchronous speeds. Consideration of power flow enables the VA rating of the secondary power source to be determined as a function of the gear ratio and online operating range of the system. A simple current source model is used to predict performance which is compared with experimental results. The results indicate a viable system, and suggestions for further work are proposed. (Author)

A82-15667 **North American tidal power prospects.** W. W. Wayne, Jr. *International Journal of Ambient Energy*, vol. 2, July 1981, p. 151-158.

Prospects for North American tidal power electrical generation are reviewed. Studies by the US Army Corps of Engineers of 90 possible generation schemes in Cobscook Bay, ME, indicated that maximum power generation rather than dependable capacity was the most economic method. Construction cost estimates for 15 MW bulb

units in a single effect mode from basin to the sea are provided; five projects were considered ranging from 110-160 MW. Additional tidal power installations are examined for: Half-Moon Cove, ME (12 MW, 18 ft tide); Cook Inlet, AK, which is shown to pose severe environmental and engineering problems due to fish migration, earthquake hazards, and 300 ft deep silt deposits; and the Bay of Fundy, Canada. This last has a 17.8 MW plant under construction in a 29 ft maximum tide area. Other tidal projects of the Maritime Provinces are reviewed, and it is noted that previous economic evaluations based on an oil price of $16/barrel are in need of revision. M.S.K.

A82-16052 Investigations on a Se-CdO photovoltaic cell. C. H. Champness, S. Fukuda, and S. Jatar (McGill University, Montreal, Canada). *Solar Energy Materials*, vol. 5, Oct. 1981, p. 391-401. 6 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada.

Based on earlier studies of Altmejd and Champness (1978), Se-CdO cells were investigated in order to determine the counter electrode deposition conditions. The cell structures were made by the Preston method using residual air. In this method CdO is reactively sputtered on a crystallized selenium film using a cadmium target in the presence of argon plus residual air; pressure is critically controlled in order to obtain the appropriate excess of cadmium in the CdO, giving a low resistivity with sufficient transparency. The spectral response is between 350 and 700 nm, and is controlled on the long wavelength side by the selenium and on the short wavelength side by the CdO. The effect of heat treatment of the selenium film in oxygen prior to CdO film deposition raised the open-circuit voltage and fill factor, resulting in a cell giving about 1.7% efficiency, without an optimized grid or antireflecting coating. Preliminary experiments were made to sputter CdO reactively on glass from gas pre-mixtures of oxygen and argon to obtain easier pressure control; these, however, did not give films of low enough resistivity coupled with high transparency. J.F.

A82-16600 Analytical solution of a simulation model for wind turbines. H. M. Power (University College, Dublin, Ireland). *Applied Energy*, vol. 9, Dec. 1981, p. 311-316.

A recently developed model for wind turbine dynamics has the form J(d omega/dt) = g(V, omega) - T, where J represents the moment of inertia of the system referred to the axis of the turbine, T is the torque absorbed by the load, and g(V, omega) is the torque generated by the turbine when rotating at omega radians/sec in a windspeed of V meters/sec. The equation of motion can be used to simulate the behavior of a turbine connected to a load having a parabolic torque versus speed characteristic by approximating any given windspeed versus time profile by a piecewise-constant variation. It is shown that, subject to the stated load, the equation of motion can be solved explicitly for any time interval during which V is considered constant. J.F.

A82-16743 Computational analysis of diffuser-augmented wind turbines. C. A. J. Fletcher (Sydney, University, Sydney, Australia). *Energy Conversion and Management*, vol. 21, no. 3, 1981, p. 175-183. 16 refs. Research supported by the Energy Authority of New South Wales and National Energy, Research Development and Demonstration Council.

Diffuser-augmented wind turbines are suitable candidates for the generation of electricity from jet-stream winds. A blade element, computational analysis is developed that includes wake rotation effects and blade Reynolds number effects. The influence of the diffuser is allowed for by introducing empirical values for the diffuser efficiency and exit-plane pressure coefficient. Good agreement is obtained for power coefficient and turbine axial velocity with experimental results. The use of screens to simulate the turbine is found to overestimate the turbine output by neglecting blade profile drag but to underestimate turbine output by neglecting favorable rotational influences on diffuser efficiency. Maximum power is delivered with a solidity ratio of 0.10 to 0.15 depending on the aerofoil section used. (Author)

A82-16827 * # Ceramics for the AGT101 automotive gas turbine. D. M. Kreiner and J. M. Wimmer. *Government Institutes, Gas Research Institute, National Coal Association, EPRI, and AGA, Energy Technology Conference, 9th, Washington, DC, Mar. 9-11, 1981, Paper.* 15 p. Contract No. DEN3-167.

An advanced gas turbine powertrain for automotive application is being developed. Objectives of the program include a fuel consumption of 42.8 mpg on No. 2 diesel fuel in a 3000 pound car, same overall vehicle performance as obtained with a conventional spark ignition internal combustion engine, low emission, multiple fuel capacity, reliability, and competitive cost. The AGT101 powertrain consists of a power section, gearbox and transmission, and the design and analysis conducted thus far support the initial engine concept, as no significant design changes have been required. The ceramic rotor design approach and component materials are discussed, and it is projected that the AGT powertrain will be competitive with any other alternative powertrain in meeting the design objectives. D.L.G.

A82-16844 Turbines in the ocean. F. G. W. Smith and R. H. Charlier (Northeastern Illinois University, Chicago, IL). *Sea Frontiers*, vol. 27, Sept.-Oct. 1981, p. 300-305.

It is noted that the relatively high-speed ocean currents flowing northward along the east coast of the U.S. may be able to supply a significant proportion of the future electric power requirements of urban areas. The Gulf Stream core lies only about 20 miles east of Miami; here its near-surface water reaches velocities of 4.3 miles per hour. Attention is called to the estimate that the energy available in the current of the Gulf Stream adjacent to Florida is approximately equivalent to that generated by 25 1,000-megawatt power plants. It is also contended that this power could be produced at competitive prices during the 1980s using large turbines moored below the ocean surface near the center of the Stream. Assuming an average ocean-current speed between 4 and 5 knots at the current core, the power density of a hydroturbine could reach 410 watts per square foot, about 100 times that of a wind-driven device of similar scale operating in an airflow of approximately 11 knots. C.R.

A82-17015 Nonlinear development of magnetic reconnection in the tearing-type and the Petschek-type field geometries. M. Ugai (Ehime University, Matsuyama, Japan). *Plasma Physics*, vol. 23, Sept. 1981, p. 857-867. 10 refs.

Distinct hydromagnetic characteristics associated with the tearing-type (Furth etal., 1963) and the Petschek-type (Petschek, 1964) field geometries are studied numerically. Both the tearing-type and the Petschek-type reconnections are initiated by a local resistive disturbance, and develop from an initially antiparallel magnetic field. In the tearing-type field geometry the current-sheet plasma, accelerated at X-type neutral points through reconnection, cannot be ejected away from the system, but is confined in the resulting magnetic islands. it is found that the nonlinear saturation oscillates as a result of the interaction between the confined plasma and the surrounding magnetic field; the period of the oscillation is approximately given by the time required for an Alfven wave to cross one wavelength. On the other hand, in the Petschek-type field geometry the plasma can freely be ejected away from the system, so that the antiparallel field is allowed to collapse into the X-type neutral point. (Author)

A82-17626 American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Edited by V. Nelson and M. Mooring (West Texas State University, Canyon, TX). Washington, DC, American Wind Energy Association, 1980. 170 p.

The state-of-the-art of large and small wind turbine applications is detailed. Large wind energy conversion systems (WECS) were examined in the light of federal programs, early operational experience with MW sized wind turbines, large Darrieus windpowered generators, legal, institutional, reliability, and cost factors, lightning protection, and implications of PURPA legislation. Evaluation procedures for vibration analysis, yaw dynamics, and hysteresis were discussed for small WECS, along with water heating applications, performance and reliability characteristics, and the aerodynamic performance of small vertical axis WECS. Topics significant to commercialization of WECS were explored, including achievable goals and wind energy assessment techniques, WECS use by rural electric systems, product liability insurance, and standards for WECS. M.S.K.

A82-17627 * # Energy potential and early operational experience for large wind turbines. W. H. Robbins and R. L. Thomas

(NASA, Washington, DC). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 7-12. 9 refs.

Projections for the total potential output of large wind turbines in the U.S. are reviewed. NASA has developed nine large wind-powered generators, of 100 kW, 200 kW, 2 MW, and 2.5 MW capacities, with rotors 100-300 ft in diameter, and all with horizontal axis. Approximately 214,000 sq miles of the U.S. have been determined as having substantial wind regimes and terrain suitable for large wind turbine siting. This translates into 340,000 Mod 2 (2.5 MW) wind turbines producing 4.9 quads of electricity annually, equivalent to saving 2.5 billion barrels of oil/yr. The cost of electricity is seen as the critical factor in utility acceptance of large wind turbines, and the Mod 2 machines are noted to achieve the 2-4 cents/kWh (1977 dollars) COE which is necessary. Problems such as pollution, including visual, auditory, EM, and land use difficulties are considered, and solutions are indicated. M.S.K.

A82-17628 # Alcoa vertical axis wind turbines. H. R. Kutcher (Alcoa Research Laboratories, Pittsburgh, PA). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 13-15.

An introductory line of vertical axis wind turbines which have been designated ALVAWTS is under development and testing. This paper describes those machines, discusses development and commercialization efforts, and provides data for three models which are believed to be cost effective for use today at sites with mean annual wind speeds in excess of 6.3 m/s (14 mph). (Author)

A82-17629 # Application of large and small wind turbine generators - A utility perspective. M. Klinger, E. J. Warchol, N. G. Butler, M. J. Berger, and R. E. Reinhart (Bonneville Power Administration, Portland, OR). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 16-19.

A82-17630 # Wind energy conversion system design and analysis program. J. S. Foley (United Technologies Research Center, East Hartford, CT). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 39-45. 5 refs.

This paper describes a computer program which was developed primarily to guide the design process of a wind energy conversion system, particularly in evaluating system concepts for the minimization of cost of energy (COE) and sizing of a wind system for maximum performance at a given wind site. It is, in effect, a complete preliminary design process which accepts, as independent variables, specifications for a WECS design (rotor diameter, rated power, etc.), and wind site characteristics (mean wind speed and shear profile), and calculates all weights, costs, and energy production quantities to arrive at a complete description of the WECS in either a single-unit or a wind-farm configuration. An important feature of the program is an internal optimization routine which can optimize one or more of four key variables (rotor RPM, rotor diameter, rated power, and tower height) for minimum COE for either a single unit or a wind farm installation. The use of the program in the design process is demonstrated for a Hamilton Standard Multi-Megawatt Wind Turbine and for UTRC's entry in the 15 kW SWECS competition. (Author)

A82-17631 # Lightning protection for composite rotor blades. H. W. Gewehr (Kaman Aerospace Corp., Bloomfield, CT). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 46-48.

The development of a lightning protection skin for all-composite windpowered turbine rotors is described. Preliminary tests revealed a necessity for lightning conductors in fiberglass blades, to eliminate high current entry into the interior of the rotor. A woven cloth of aluminized glass fibers was incrementally built up until a 200,000 Amp current could be survived. A full-chord aluminum tip cap and a coated trailing edge braid on the Mod 1 blades is considered effective protection of up to a 200,000 Amp lightning stroke. Further tests to determine adequate protection for a 40 kW wind turbine are indicated. It is noted that lightning will not penetrate a one inch thick fiberglass composite spar wall if there is no metal inside the spar, lightning will penetrate a .060 in. fiberglass afterbody skin to reach a wet paper core, and lightning conductors must be firmly attached to the structure. M.S.K.

A82-17633 # Operations of small wind turbines on a distribution system. D. Curtice (Systems Control, Inc., Palo Alto, CA). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 55-59.

The technical aspects of interconnecting a small wind energy conversion system (SWECS) with a utility grid are examined. Four commercially available wind turbines with outputs less than 100 kW were studied, covering the gamut of induction generator, self- and line-commutated inverters, and a synchronous generator. Penetrations of 5, 20, and 50% of the total utility power output were considered. Effects on utility protection equipment coordination were found to be safe with regard to overcurrent devices, noting that a SWECS would respond to a three-phase utility fault. Isolated operation was found to be possible with synchronous and self-commutated SWECS, and a disconnect switch is necessary to protect line workers during repair periods. The growth of SWECS penetration into the total power of a grid is expected to be gradual, and voltage flicker can be fixed by a simple device to prevent sudden large inputs by a SWECS. M.S.K.

A82-17634 # Overview of the Wind Energy Application Network for Hawaii. D. R. Neill (Hawaii Natural Energy Institute, Honolulu, HI). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 60-67.

A82-17635 # Enertech High Reliability prototype vibration analysis. J. H. Sexton (Rockwell International Corp., Rocky Flats Plant, Golden, CO). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 71-75.

Modal analysis techniques were experimentally applied to study the dynamic interaction between a wind turbine generator and its support tower. Details of the techniques applied and corresponding results are discussed. Results of vibration tests indicate the Enertech High-Reliability wind turbine generator (WTG/support structure) second mode bending was 13.2 Hz, while the blade's first mode bending frequencies were 12.4 Hz for blade two and 14.6 Hz for blade one. Significant WTG/tower response was observed and recorded during WTG operation which was traced to this system response characteristic. (Author)

A82-17636 # Evaluation of wind turbine generator operational hysteresis using 'Method of Bins'. C. A. Waldon (Rockwell International Corp., Rocky Flats Plant, Golden, CO). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 76-80.

A two-dimensional method-of-bins data processing system for a small wind energy conversion system (SWECS) is used to demonstrate the production of a composite power curve. The curve takes into account hysteresis occurring during different wind regimes, and is combined with a Weibull distribution for windspeed and duration for site specific output calculations. An example is provided for a 1 kW horizontal axis SWECS, including modifications to the program to account for blade-pitch and/or tail furling safety mechanisms which prevent SWECS overspeed. The action of hysteresis can be accounted for by including parameters for rotor pitch, tail position, and wind tracking, and requires multidimensional bins for accurate predictions of power output. M.S.K.

A82-17637 # Yaw dynamics of a horizontal axis wind turbine. R. Kirchhoff, D. Cromack, and R. Cohen (Massachusetts,

University, Amherst, MA). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 81-87. 5 refs.

The dynamics of horizontal axis wind turbine response in yaw are analyzed. A model is explored consisting of an ellipsoidal nacelle, a rigid pole, no wind shear, and zero coning in the rotor blades. The torque applied to the nacelle and the rotor blades, due to gyroscopic, Coriolis, and damping forces are considered linearly. A coordinate system for the moment of inertia and the angular acceleration is devised, and the pressures on each blade (3 blades in the study) are integrated. The possibility of a coupling between the wind speed and the lowest natural frequency is suggested, and experiments with a non-rigid tower are indicated to examine a configuration where Coriolis forces may dominate. M.S.K.

A82-17638 # Experiences with a Grumman windstream 25. L. H. Soderholm (Science and Education Administration, Ames, IA). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 90-92.

Features of a new 3-bladed, 15 kW, downwind horizontal axis wind turbine are described. The windpowered generator has passive yaw, a 25 ft blade diameter, is rated at 26 mph, and uses a 20 kW brushless, self-excited alternator. Proper lubricating oil for ambient conditions was found to be necessary to maintain efficient operation in extreme weather conditions. A solid shaft has eliminated low-stress fatigue in the hub-propellor connection, and corrosion-proof materials have been incorporated in the blade pitch control limit switches. It is noted that including easy access on the ground to all electronic circuits and circuit breakers enhances the saftey and utility of a small wind energy conversion system (SWECS). It is summarizerl that the provision of easy installation, safety control redundancy, proper yaw orientation forces, accurate stress evaluation, and proper generator excitation are necessary for the acceptance of SWECS. M.S.K.

A82-17639 # Wind driven fluid devices for water heating. M. Rolland and D. Cromack (Massachusetts, University, Amherst, MA). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 93-95. 7 refs.

Present techniques for analysis of water brake applications to wind energy conversion systems was shown to be inadequate for moderate to large scale wind turbines. Several vaned hydraulic energy converters are compared for size, speed, and capacity to identify devices suitable for wind turbine applications. A parametric relationship is developed to aid the designer in choice of an appropriate device. Examples of specific systems are presented with emphasis on domestic, agricultural, and industrial applications. (Author)

A82-17640 # Development of high-performance, high-reliability windpower generators. K. H. Bergey (Bergey Windpower Co., Inc., Norman, OK). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 101-105.

The BWC 650 and BWC 1000 windpower generators represent a new approach to high-performance and high-reliability for small windpower machines. Their variable pitch rotor system consists of torsionally flexible blades combined with out-of-plane balance weights. The resulting Powerflex blade system provides the performance advantages of variable pitch blades while maintaining fixed pitch simplicity. The permanent magnet alternators used in the two models are designed for low speed operation without the need for step-up gear boxes. The Autofurl tail automatically turns the rotor out of the wind above 32 mph. When the winds subside, it turns the rotor back into the wind. Development problems and testing techniques are discussed, including fatigue testing, dynamic blade angle measurements, and tower tests under actual storm conditions. (Author)

A82-17641 # Analytical evaluation of the aerodynamic performance of a high-reliability vertical-axis wind turbine. R. B. Noll (Aerospace Systems, Inc., Burlington, MA) and N. D. Ham (MIT, Cambridge, MA). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 106-113. 13 refs. Research supported by the Rockwell International Corp.

The aerodynamic performance of a high-reliability vertical-axis wind turbine is discussed. The turbine has three, straight blades which are cyclically pitched. Due to its unique configuration, aerodynamic performance models used for classical horizontal-axis machines and for the vertical-axis Darrieus wind machines are not applicable. Therefore, an analytical model was formulated for the turbine aerodynamic performance and has been programmed for computer calculation. Both the mathematical model and computer program VAPE (Vertical-axis wind turbine Aerodynamic Performance Evaluation) are discussed. Connections for strut drag, turbulent wake state, and dynamic stall are included. (Author)

A82-17642 # Controlled velocity testing of small wind energy conversion systems - An evaluation of a technique. J. C. Balcerak (Rockwell International Corp., Golden, CO). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 114-119.

The results of tests of small wind energy conversion systems (SWECS) on board moving railroad flatcars are reported. Mounting the SWECS on the flatcars allowed testing at different fixed speeds and orientations. Initial tests determined the power curve of the machines, the wind velocity profile over a flatcar, and the acceleration/deceleration effects on the towers. Testing procedures on the 4000 ft long rail track are described, as are preliminary steps to define wake profiles behind the moving SWECS blades. Power curves for several manufacturers machines are provided, and it is observed that the output of two machines greatly exceeded the manufacturers predictions, due to a continued increase of rotor speed with increasing wind velocity. Continuation and expansion of the moving bed test facility for SWECS is recommended on a reimbursible basis. M.S.K.

A82-17643 # First results from the UMass wind tunnel test program. L. W. Slager (Massachusetts, University, Amherst, MA). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 120-128. 17 refs.

Along with the recently reported theoretical-experimental study comparing lifting line theory (with Reynolds number corrections) predictions to results of wind tunnel model tests of three foot diameter rotors, an ongoing series of tests exploring such effects as pitch angle, coning angle, solidity, number of blades, surface roughness, and tower shadow have been and are being carried out. These tests are being performed on both optimum and nonoptimum (linear taper, linear twist and constant chord, zero twist) horizontal axis rotors. In addition, sailwing and Darrieus-type rotors in various configurations are also being tested. Some results for the above tests will be presented. These results establish the credibility of small model testing and the need for careful rotor design by considering other effects than just twist and chord distribution. They also confirm theory in some cases and are at variance in others. Qualitative explanations (using system dynamics or other variables) are offered and suggestions for future research are made. (Author)

A82-17644 # SWECS technology - State-of-the-art and achievable goals. R. P. Cingo (Rockwell International Corp., Pittsburgh, PA). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 131-138.

The progress of the development of commercially-ready small wind energy conversion systems (SWECS) is summarized, along with suggestions for applications of improvements. Six commercially available machines and seven DOE prototype SWECS were examined for kWh/yr per lb of material, kWh/yr per sq m of swept area, dollars/lb in manufacture, and cost of energy in cents/kWh. Significant advancements in the economics of SWECS were found with the use of poltruded blades, induction molding techniques, and

aerodynamically controlled rotors. The development of a standard, dual output gearbox for multiple applications is recommended, as well as cataloguing tower dynamics characteristics, the design of components specifically for SWECS use, and the introduction of low-cost installation procedures. Finally, it is noted that reliability and system life for SWECS are two relatively unknown factors. M.S.K.

A82-17846 # Performance testing and rating standards for Wind Energy Conversion Systems. M. Bergey (Bergey Windpower Co., Inc., Norman, OK). In: American Wind Energy Association, National Conference, Pittsburgh, PA, June 8-11, 1980, Proceedings. Washington, DC, American Wind Energy Association, 1980, p. 163-167.

A82-17889 * # End region and current consolidation effects upon the performance of an MHD channel for the ETF conceptual design. S. Y. Wang and J. M. Smith (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0325.* 5 p. 6 refs.

It is noted that operating conditions which yielded a peak thermodynamic efficiency (41%) for an EFT-size MHD/steam power plant were previously (Wang et al., 1981; Staiger, 1981) identified by considering only the active region (the primary portion for power production) of an MHD channel. These previous efforts are extended here to include an investigation of the effects of the channel end regions on overall power generation. Considering these effects, the peak plant thermodynamic efficiency is found to be slightly lowered (40.7%); the channel operating point for peak efficiency is shifted to the supersonic mode (Mach number of approximately 1.1) rather than the previous subsonic operation (Mach number of approximately 0.9). Also discussed is the sensitivity of the channel performance to the B-field, diffuser recovery coefficient, channel load parameter, Mach number, and combustor pressure. C.R.

A82-17913 # Optical diagnostic techniques for coal-fired MHD applications. D. L. Murphree, R. L. Cook, L. E. Bauman, E. J. Beiting, R. E. Stickel, R. O. Daubach, and M. F. Ali (Mississippi State University, Mississippi State, MS). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0377.* 19 p. 32 refs. Contract No. DE-AC02-80ET-15601.

Microprocessor-controlled, optical diagnostic instrumentation has been developed for the measurement of gas temperature, gas velocity and turbulence profiles, slag temperature and emissivity, optical transmission, and nitric oxide concentration in the particle/seed-laden, coal-fired magnetohydrodynamic (MHD) gas stream. Both a performance evaluation of these systems on DOE/MHD test facilities and the resulting diagnostic data on MHD/HRSR components are presented. Preliminary results of the Coherent anti-Stokes Raman Spectroscopy technique for spatially and temporally resolved temperature measurements in this harsh MHD environment are presented. (Author)

A82-17914 # MHD coal combustor development. J. Hardgrove, M. Bauer, H. Iwata, and R. Hamberg (TRW Energy Development Group, Redondo Beach, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0380.* 10 p. Contracts No. DE-AC22-79ET-11053; No. DE-AC22-81PC-40502.

The development status of 10 and 20 MW(thermal) MHD slagging coal combustors that have been selected by the DOE for scaling to the 50 MW size for integrated power train testing is surveyed. The results of a recently completed endurance demonstration of the 20 MW combustor are also discussed. A summary is given of the various types of coal combustors that have been experimentally evaluated during the past six years in the U.S. and Poland. The design of the combustors involves a cylindrical horizontal vortex flow combustion chamber with tangential oxidizer injection and axial gas outflow. The slag flows essentially under the influence of gas shear and is tapped near the combustor exit. No significant hardware problems have been encountered with the combustor components operating over 271 hours and being subjected to high thermal cycling (more than 400 cycles). C.R.

A82-17922 # MHD generator scaling analysis for baseload commercial power plants. D. W. Swallom and C. C. P. Pian (Avco Everett Research Laboratory, Inc., Everett, MA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0394.* 11 p. 5 refs. Contract No. DE-AC01-80ET-15614.

MHD generator channel scaling analyses have been performed to definitize the effect of generator size and oxygen enrichment on channel performance. These studies have shown that MHD generator channels can be designed to operate efficiently over the range of 250 to 2135 thermal megawatts. The optimum design conditions for each of the thermal inputs were established by investigating various combinations of electrical load parameters, pressure ratios, magnetic field profiles, and channel lengths. These results provide design flexibility for the baseload combined cycle MHD/steam power plant. (Author)

A82-17923 # Loading schemes for a 50 MW/th/ diagonally connected MHD generator. C. C. P. Pian and A. M. Demirjian (Avco Everett Research Laboratory, Inc., Everett, MA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0395.* 8 p. Contract No. DE-AC01-80ET-15614.

The characteristics of diagonally connected subsonic MHD generators operating with and without current control/power shuffle circuits are investigated. The results of the analysis are presented for the 50 MW(th) CDIF 1B2 generator. It is shown that an axial current flows in the uncontrolled diagonal generator, which decreases the generator's performance. Electrode current control circuits can be used as power shufflers to eliminate the axial current and to improve the efficiency. The improved performance efficiency can be maintained to part-load conditions when the inverter, channel and combustor controls are integrated. Control requirements for generators with mid-channel power taps are also discussed. (Author)

A82-17941 * # Impact of uniform electrode current distribution on ETF. D. J. Bents (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0423.* 8 p. 5 refs.

A basic reason for the complexity and sheer volume of electrode consolidation hardware in the MHD ETF Powertrain system is the channel electrode current distribution, which is non-uniform. If the channel design is altered to provide uniform electrode current distribution, the amount of hardware required decreases considerably, but at the possible expense of degraded channel performance. This paper explains the design impacts on the ETF electrode consolidation network associated with uniform channel electrode current distribution, and presents the alternate consolidation designs which occur. They are compared to the baseline (non-uniform current) design with respect to performance, and hardware requirements. A rational basis is presented for comparing the requirements for the different designs and the savings that result from uniform current distribution. Performance and cost impacts upon the combined cycle plant are discussed. (Author)

A82-18124 International Symposium on Wave and Tidal Energy, 2nd, St. John's College, Cambridge, England, September 23-25, 1981, Proceedings. Symposium sponsored by the British Hydromechanics Research Association. Edited by H. S. Stephens and C. A. Stapleton (British Hydromechanics Research Association, Cranfield, Beds., England). Cranfield, Beds., England, BHRA Fluid Engineering, 1981. 447 p.

Topics discussed include wave power device interactions, the mathematical modeling of tidal power, and wave power with air turbines. Particular attention is given to the hydrodynamic characteristics of the Bristol Cylinder, the Strangford Lough tidal energy project, and the Foilpropeller for wave power propulsion. Consideration is also given to a submerged oscillating water column device, models of wave energy transformation near a coast, and the environmental implications of tidal power. J.F.

A82-18201 Possible application of electromagnetic guns to impact fusion. R. N. Kostoff (U.S. Department of Energy, Washington, DC), A. T. Peaslee, Jr. (Los Alamos National Laboratory, Los

Alamos, NM), and F. L. Ribe (Washington, University, Seattle, WA). *(U.S. Army Armaments Research and Development Command and Defense Advanced Research Projects Agency, Conference on Electromagnetic Guns and Launchers, San Diego, CA, Nov. 4-6, 1980.) IEEE Transactions on Magnetics*, vol. MAG-18, Jan. 1982, p. 194-198. 21 refs. Research sponsored by the U.S. Department of Energy.

The possible application of electromagnetic guns to impact fusion for the generation of electric power is discussed, and advantages of impact fusion over the more conventional inertial confinement fusion concepts are examined. It is shown that impact fusion can achieve the necessary high yields, of the order of a few gigajoules, which are difficult to achieve with lasers except at unrealistically high target gains. The rail gun accelerator is well adapted to the delivery of some 10-100 megajoules of energy to the fusion target, and the electrical technology involved is relatively simple: inductive storage or rotating machinery and capacitors. It is concluded that the rail gun has the potential of developing into an impact fusion macroparticle accelerator. V.L.

A82-18220 # **Experimental demonstration of the feasibility of the Mist Flow Ocean Thermal Energy Process.** S. L. Ridgway, C. K. B. Lee, and R. P. Hammond (R & D Associates, Marina del Rey, CA). *American Institute of Aeronautics and Astronautics, Terrestrial Energy Systems Conference, 2nd, Colorado Springs, CO, Dec. 1-3, 1981, Paper 81-2596.* 8 p. 9 refs. Research sponsored by the U.S. Department of Energy.

The Mist Flow Ocean Thermal Energy Process is a practical method for exploiting the ocean temperature difference without using heat exchangers or large vapor turbines. Warm ocean surface water is sprayed upward into the bottom of an evacuated vertical duct. Vapor flashes from the sprayed water droplets and drags them upward as it proceeds to the top of the duct. There the vapor is condensed by cold water obtained from the depths. The validity of the concept has been demonstrated in a set of experiments conducted in a 4-meter tall transparent test column of 23 x 36 cm cross section. The coupling between the vapor and the droplets remained strong as energy equivalent to over 60 meters of lift was transferred from the vapor to the water droplets. Power plant designs based on these experimental data imply costs of about $1,200 per kilowatt for power plant sizes in the 10 MW range. Power plants operating with only 16 C temperature difference appear practical.
(Author)

A82-18328 # **Performance of a small low speed Darrieus type rotor.** G. Ahmadi (Shiraz University, Shiraz, Iran). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 26, May-June 1981, p. 489-494. 15 refs. Research supported by Shiraz University.

A model for the performance of a small, low speed, high chordal ratio Darrieus is presented. A tip speed ratio below 1.5 was chosen, and experiments on a test machine with NACA 0012 blades with a 12 cm chord are reported. The wood blades were 32.5 cm long, vertically mounted, and spaced 33.6 cm apart, yielding the chord to diameter ratio of 0.7. The Darrieus was tested at varying speeds and pitch angles, and power coefficients were calculated. A 7.5 deg pitch angle was determined to be optimum for the model, with efficiency increasing with windspeed. The high chordal ratio resulted in low power coefficients being obtained, near 5 percent at 20 m/sec.
M.S.K.

A82-18394 Design of a cell for electrode kinetic investigations of fuel cell reactions. H. Olender, J. McBreen, W. E. O'Grady, S. Srinivasan (Brookhaven National Laboratory, Upton, NY), and K. V. Kordesch (Graz, Technische Universität, Graz, Austria). *Electrochemical Society Journal*, vol. 129, Jan. 1982, p. 135-137. 10 refs. Contract No. DE-AC02-76CH-00016.

Two designs of a cell for investigation of electrode kinetics of fuel cell reactions in acid media are described. The cells are suitable for evaluation of carbon supported platinum electrodes under conditions simulating a phosphoric acid fuel cell environment at elevated temperature and pressure. The usefulness of this for obtaining fuel cell performance, overpotential-current density relation, and in situ platinum surface area measurements in 98.6% H3PO4 at 150 C is demonstrated. The cell design is also ideal for the electrochemical determination of cross migration of oxygen through the matrix at 180 C. (Author)

A82-18466 Electrical properties of infrared photovoltaic Cd/x/Hg/1-x/Te detectors. P. Becla and E. Placzek-Popko (Wroclaw, Politechnika, Wroclaw, Poland). *Infrared Physics*, vol. 21, Nov. 1981, p. 323-332. 16 refs.

N82-10005 West Virginia Univ., Morgantown.
AN INDOOR BLADE TEST FACILITY FOR DETERMINING THE BASIC AERODYNAMIC PROPERTIES OF DARRIEUS WIND TURBINE AIRFOILS WITH TEST RESULTS FOR AN NACA 0015 AND A MODIFIED SECTION Ph.D. Thesis
Walter Paul Wolfe 1981 332 p
Avail: Univ. Microfilms Order No. 8118421

An indoor facility was developed for use in the aerodynamic testing of Darrieus wind turbine blades. A three component strain gage balance was used to reduce lift, drag, and moment coefficients of blades whose angle of attack, chord to radius ratio and Reynolds number could be systematically varied. A computer data acquisition system was developed to automatically record, reduce, and save the test data. It was learned that the unusual flow field of this test environment necessitates unique induced velocity corrections to the test data. Computer codes were developed to calculate the angles of attack induced at the blade by the trailing tip vortices. The results were then used to correct the test data. The effects of flow curvature on blade aerodynamics were experimentally verified. Both blades demonstrated virtual camber and incidence as evidenced by non-zero moment coefficients and angles of zero lift and minimum drag.
Dissert. Abstr.

N82-10406# General Electric Co., St. Petersburg, Fla. Gas Turbine Div.
WATER-COOLED GAS TURBINE DEVELOPMENT PROGRAM Final Report
Jun. 1981 249 p Sponsored in part by Electric Power Research Inst. 2 Vol.
(EPRI Proj. 234-3)
(DE81-904245; EPRI-AP-1889-Vol-1) Avail: NTIS HC A11/MF A01

Work on the EPRI water cooled gas turbine development program, RP234 is summarized. The viability of water cooling to achieve higher firing temperatures and increased fuels flexibility in utility gas turbines was established. It is found that water cooling is a viable concept and that it results in considerable improvements in gas turbine combined cycle efficiency at increased firing temperatures. DOE

N82-10434# Sandia Labs., Albuquerque, N. Mex.
RESIDUAL STRESSES IN DARRIEUS VERTICAL AXIS WIND TURBINE BLADES
P. Veers Apr. 1981 63 p
(Contract DE-AC04-76DP-00789)
(DE81-1026144; SAND-81-0923) Avail: NTIS HC A04/MF A01

A numerical package called RESID was essential to calculate the residual stresses in VAWT blades induced during cold forming. Using a strength of materials - elementary beam theory approach, RESID models the material response with a bilinear stress-strain curve, and the cross sectional geometry with an array of area increments. Through an iterative solution procedure residual stresses are predicted for a specified final radius of curvature or applied bending moment. Results are compared to theoretical solutions for simple geometries and with MARC Finite element results for VAWT blade geometries. Calculating residual stress levels, determining acceptable residual stress levels, and a method of reducing residual stresses are discussed. A complete listing and sample run are inclined in the appendexes. DOE

N82-10452# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastic.
CALCULATION OF NATURAL MODES OF VIBRATION FOR ROTOR BLADES BY THE FINITE ELEMENT METHOD
Fritz Kiessling and Dieter Ludwig Jan. 1981 66 p refs In GERMAN; ENGLISH summary
(DFVLR-FB-81-07) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 14,20

The mass and stiffness matrices for a rotating blade are established by the finite element method. The formulation is

based on the Lagrange function presented for combined flapwise bending, chordwise bending, and torsion of twisted nonuniform rotor blades. The element matrices were created by the nonnumeric computer program REDUCE by which it is possible to evaluate the formulas by symbolic manipulation. An ordering scheme was introduced to demonstrate which terms were simplified or neglected. As examples, eigenanalyses are performed for a nonrotating homogeneous beam and for the rotor blade of a wind energy converter. Author (ESA)

N82-10492 Texas A&M Univ., College Station.
A COMPUTER MODEL OF A STIRLING ENGINE USING A TWO-PHASE TWO-COMPONENT WORKING FLUID Ph.D. Thesis
David Allen Renfroe 1981 193 p
Avail: Univ. Microfilms Order No. 8118295

Stirling engines are potentially the most efficient converters of thermal energy to mechanical work that are manufacturable. In addition to its high efficiency capability, it also operates relatively cleanly, quietly, and with multiple fuel capability. Its one deficiency is the low specific power (power output/engine size.) A method of increasing specific power is described. This is by utilizing a two-phase two-component (TPTC) working fluid or one having a carrier gas and a component which changes phase during the cycle, such as a mixture of water and air. In order to study the effect of adding water to the working fluid of a Stirling engine on its operation, a computer model of the system was developed. The TPTC model is an extension of a Stirling engine with an ideal gas working fluid and includes provisions for accounting for differences in heat transfer and flow losses for a TPTC working fluid. Dissert. Abstr.

N82-10493 Virginia Univ., Charlottesville.
FUNDAMENTAL INVESTIGATIONS ON FUEL CELLS FOR TRANSPORTATION APPLICATIONS Ph.D. Thesis
Earl Jennings Taylor 1981 268 p
Avail: Univ. Microfilms Order No. 8117914

Three areas concerning fuel cells for transportation applications were investigated. The areas are: (1) a comparison of oxygen reduction in phosphoric acid and in trifluoromethanesulfonic acid, (TFMSA); (2) testing of three types of fuel cells under simulated vehicular operating conditions; and (3) the design, fabrication, and testing of a 1/2-kilowatt alkaline fuel cell module. Additions of TFMSA to phosphoric acid enhance the oxygen reduction in phosphoric acid. It is shown that the single cell has no adverse effect on fuel cell performance in simulated automobile power requirements. It is demonstrated that the single cells can be scaled-up without loss of performance. Author

N82-10494 Princeton Univ., N. J.
THE PLASMADYNAMICS AND IONIZATION KINETICS OF THERMIONIC ENERGY CONVERSION Ph.D. Thesis
John Langie Lawless, Jr. 1981 198 p
Avail: Univ. Microfilms Order No. 8118339

Radiation by a Cesium recombination laser operating in a different thermionic converter as an energy efficient process is discussed. To reduce the plasma arc drop, thermionic energy conversion was studied. It is predicted that it is possible to generate the required laser light from a thermionic-type Cesium plasma. A numerical method is developed to solve the thermionic plasma dynamics. The effects of the complete system of electron atom inelastic collisions on the ionization recombination problem are reduced to a simple system one quantum approximation. A Cesium recombination laser is predicted and the magnitudes for the population inversion and the laser efficiency are derived. Thermionic converter performance using laser radiation is considered. It is found that laser radiation impinging on a thermionic plasma enhances the ionization process thereby raising the plasma density and reducing the plasma arc drop. Dissert. Abstr.

N82-10495*# Gilbert/Commonwealth, Reading, Pa.
MAGNETOHYDRODYNAMICS MHD ENGINEERING TEST FACILITY ETF 200 MWE POWER PLANT. CONCEPTUAL DESIGN ENGINEERING REPORT CDER. VOLUME 3: COSTS AND SCHEDULES Final Report
Sep. 1981 61 p 5 Vol.
(Contracts DEN3-224; DE-AI01-77ET-10769)
(NASA-CR-165452-Vol-3; DOE/NASA/0224-1-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 10B

The estimated plant capital cost for a coal fired 200 MWE electric generating plant with open cycle magnetohydrodynamics is divided into principal accounts based on Federal Energy Regulatory Commission account structure. Each principal account is defined and its estimated cost subdivided into identifiable and major equipment systems. The cost data sources for compiling the estimates, cost parameters, allotments, assumptions, and contingencies, are discussed. Uncertainties associated with developing the costs are quantified to show the confidence level acquired. Guidelines established in preparing the estimated costs are included. Based on an overall milestone schedule related to conventional power plant scheduling experience and starting procurement of MHD components during the preliminary design phase there is a 6 1/2-year construction period. The duration of the project from start to commercial operation is 79 months. The engineering phase of the project is 4 1/2 years, the construction duration following the start of the man power block is 37 months. A.R.H.

N82-10524# Little (Arthur D.), Inc., Cambridge, Mass.
LARGE WIND TURBINE GENERATOR PERFORMANCE ASSESSMENT, TECHNOLOGY STATUS REPORT NO. 3 Interim Report
W. A. Vachon Jul. 1981 136 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1348-1)
(DE81-903763; EPRI-AP-1959) Avail: NTIS HC A07/MF A01

Detailed summaries of test results are presented for the US Department of Energy's 200-kW MOD-0A horizontal-axis WTs that were interconnected with electric utilities at various locations around the United States. A description of the progress and experiences with both the MOD-1 1.5-MW WT and the cluster of three MOD-2 2.5-MW WTs is also presented, along with a summary of plans for the DOE vertical-axis wind turbine program. A brief summary of Danish large WT programs is also provided. DOE

N82-10536# Tata Energy Research Inst., Bombay (India). Documentation Center.
WATER-PUMPING-WINDMILL DESIGNS: A HANDBOOK
Tarangini Rastogi, comp. and Narsing R. Rao, comp. Jun. 1981 162 p refs
(DE81-904016; NP-1904016) Avail: NTIS HC A08/MF A01

Windmills are becoming an attractive proposition for water pumping in the rural areas. Information on designs of water pumping windmills which could be constructed with inexpensive and locally available materials and skills is presented. This handbook covers about 23 indigeneous windmill designs and information such as name of the designer, institutional affiliation, type of windmill, specific applications and suitability, design features, and operating data wherever available. Most of these designs tested and were successfully used in different parts of the world. Commercially obtainable windmills listed along with complete address of the manufacturers and relevant technical specifications. T.M.

N82-10553# Argonne National Lab., Ill.
LIQUID-METAL MHD FOR SOLAR AND COAL
E. S. Pierson, D. Cohen, and S. J. Grammel 1980 10 p refs Presented at the 7th Intern. Conf on MHD Elect. Power Generation, Cambridge, Mass., 16-20 Jun. 1980
(Contract W-31-109-eng-38)
(DE81-023545; CONF-800617-8) Avail: NTIS HC A02/MF A01

The two phase generator, liquid metal magnetohydrodynamic energy conversion system has an inherently thermodynamic efficiency for the same heat source and sink temperatures and is better suited for cogeneration than other conversion systems. For solar applications, attractive efficiencies in comparison with alternative systems are calculated, and cogeneration advantages are indicated. For coal applications, recent coal combustion gas copper reaction results show that the copper can be used to control SO2 emissions. DOE

N82-10559# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
FABRICATION, TESTING, AND MODELING PLANS FOR A 125-KW COUNTER-ROTATING-TURBINE WAVE ENERGY CONVERTER
J. Miles and T. Penney Jun. 1981 12 p refs Presented at the 8th Ocean Energy Conf., Washington, D.C., 7-11 Jun. 1981
(Contract EG-77-C-01-4042)
(DE81-023946; SERI/TP-634/1215; CONF-810622-4) Avail:

NTIS HC A02/MF A01

An air turbine accepting bi-directional flow and featuring counter-rotating turbine wheels is described. The turbine is for use with an oscillating water column and an air chamber to form a wave energy converter. Plans are presented for testing the turbine in a steady-state manner so as to obtain output torque and mass flow as functions of operational parameters. Concurrent modeling studies are described which will lead to the design of an optimized airchamber. DOE

N82-10882# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
KEY CONTRIBUTIONS IN MHD POWER GENERATION Quarterly Technical Progress Report, 1 Mar. - 31 May 1980
J. F. Louis May 1981 162 p refs
(Contract DE-AC01-79ET-15518)
(DE81-028121; DOE/ET-15518/5) Avail: NTIS HC A08/MF A01

Progress is reported in (1) investigating electrical behavior in the vicinity of electrode and insulating walls; (2) studying critical performance issues in the development of combustion disk generators; (3) developing and testing electrode modules (including studies of insulator properties); (4) determining coal combustion kinetics and ash behavior relevant to two-stage MHD combustors, and (5) investigating the mixing and flow aerodynamics of a high swirl geometry second stage. DOE

N82-10888# TRW Defense and Space Systems Group, Redondo Beach, Calif. Combustion and Power Technology Dept.
HIGH PRESSURE MHD COAL COMBUSTORS INVESTIGATION, PHASE 2 Final Technical Report
H. Iwata and R. Hamberg May 1981 129 p
(Contract DE-AC22-78ET-11053)
(DE81-027238; DOE/ET-11053/T1; FE-2706-43) Avail: NTIS HC A07/MF A01

A high pressure MHD coal combustor was investigated. The purpose was to acquire basic design and support engineering data through systematic combustion experiments at the 10 and 20 thermal megawatt size and to design a 50 MW/sub t/ combustor. This combustor is to produce an electrically conductive plasma generated by the direct combustion of pulverized coal with hot oxygen enriched vitiated air that is seeded with potassium carbonate. Vitiated air and oxygen are used as the oxidizer, however, preheated air will ultimately be used as the oxidizer in coal fired MHD combustors. DOE

N82-10936 City Univ. of New York, N. Y.
THERMOELECTRIC CONVERSIONS BASED ON NOISE RECTIFICATION Ph.D. Thesis
Andrei Cernasov 1981 178 p
Avail: Univ. Microfilms Order No. 8119649

A complete analysis of the feasibility, operation, and performance of heat engines based on the rectification of thermal noise is presented. Both the close to thermodynamic equilibrium and 'far from thermodynamic equilibrium' cases are considered. All standard thermodynamic results, including the Second Law, are found to hold for all cases. While high efficiencies and output power densities are possible, if normal exponential type diodes are used the small physical sizes of efficient fluctuation heat engines are beyond the capabilities of present technology. However, no thermodynamics reasons for the weakly nonlinear character of practical diodes, like PN junctions, are found. Since high nonlinearity ca compensate for large system sizes, when highly nonlinear diodes are discovered, efficient fluctuation heat engines could become feasible. Dissert. Abstr.

N82-10961# Los Alamos Scientific Lab., N. Mex.
DESIGN CONSIDERATIONS FOR VEHICULAR FUEL CELL POWER PLANTS
D. K. Lynn, J. B. McCormick, R. E. Bobbett, S. Srinivasan, and J. R. Huff 31 Mar. 1981 14 p refs Presented at 16th Intersoc. Energy Conversion Engr. Conf., Atlanta, 9-14 Aug. 1981
(Contract W-7405-eng-36)
(DE81-769737; LA-UR-81-1054; CONF-810812-7) Avail: NTIS HC A02/MF A01

Designs in fuel cells as an efficient, nonpolluting vehicular power source that can operate on nonpetroleum fuel were investigated. Phosphoric acid fuel cell power plant designs were studied to determine the performance level they would provide, both for a compact passenger vehicle and a 40 ft city bus. The fuel is steam reformed methanol. It is indicated that 1978 fuel cell technology provides a 22 to 50% improvement in fuel economy over the 1980 EPA estimate for the conventionally powered General Motors X car. A reasonable advanced in fuel cell technology improves performance and fuel consumption of both vehicles substantially. DOE

N82-11044# Sandia Labs., Albuquerque, N. Mex. Advanced Energy Projects Div.
WIND RIPPLE ANALYSIS
R. E. Akins 1981 8 p refs
(Contract DE-AC04-76DP-00789)
(DE81-030129; DOE/DP-00789/T15) Avail: NTIS HC A02/MF A01

Experimental techniques were developed which allow analysis of full scale performance of wind turbines with particular emphasis on the effects caused by turbulence in the incident wind. These techniques are presented, using data from the DOE/Sandia Vertical Axis Wind Turbine program. Three techniques were developed for use in evaluating the fluctuating output of a wind turbine. Techniques were sought which allowed accurate assessment of the wind ripple of the contributions to the fluctuation in turbine output caused by atmospheric turbulence. The advantages and disadvantages of these techniques are addressed. DOE

N82-11045# Washington Univ. Technology Associates, Inc., St. Louis, Mo.
YAWING OF WIND TURBINES WITH BLADE CYCLIC PITCH VARIATION
K. H. Hohenemser, A. H. P. Swift, and D. A. Peters Aug. 1981 15 p
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE81-030091; SERI/TR-8085-3-T1) Avail: NTIS HC A02/MF A01

A two-bladed wind rotor with passive cyclic pitch variation, yawed for the purpose of rotor speed and torque control was studied to determine the potential cost effectiveness of wind energy conversion. A simple mechanism adopted from rotorcraft technology for obtaining passive cyclic pitch variation makes rapid yaw rates possible without causing vibratory hub moments and without producing appreciable out-of-plane blade excursions. A 7.6 m diameter vane stabilized fully instrumented wind rotor having low blade solidity was operated 1980, during 41 days for 96 hours. The operational envelope extended to 16m/sec wind velocity, to 45 degree yaw angle power on and 80 degree yaw angle power off. The rotor was automatically yawed when 228 rpm at 10 kW rotor power was exceeded. Reverse yawing was performed manually. Within the tested performance envelope, loads and vibrations were low. The rotor ran smoothly even at high yaw angles and at high yaw rates. DOE

N82-11173# National Bureau of Standards, Washington, D.C. Chemical Stability and Corrosion Div.
MASS SPECTROMETRIC STUDIES OF MHD SLAG THERMOCHEMISTRY Interim Report
J. W. Hastie and E. R. Plante Jun. 1981 36 p refs
(PB81-221434; NBSIR-81-2293) Avail: NTIS HC A03/MF A01 CSCL 07D

The following potassium-containing systems were studied: binary mixtures of K2O with SiO2, Al2O3, Fe2O3, and ZrO2; a series of more complex synthetic slags containing K2O, SiO2, CaO, MgO, Al2O3, and Fe2O3; and MHD channel slag (Illinois No. 6 coal); and several slag-NaCl mixtures. Data were obtained over a sufficiently wide range of component-type, composition and temperature to reveal systematic trends in slag activities from which empirical predictions are possible. However, anomalous behavior was also noted, mainly in the form of nonequilibrium effects. Application of the vaporization and activity data to plasma-slag interaction and to the recovery of potassium seed from slag is also considered. GRA

N82-11380# Cherrywood Farms, Williamsburg, Mich.
PROJECT DEMONSTRATION OF WIND-TURBINE ELECTRICITY: INTERCONNECTING A NORTHERN MICHIGAN FRUIT FARM WITH A MAJOR UTILITY Interim Report, 2 Sep. 1980 - 27 Apr. 1981
David M. Amon 1981 86 p
(Contract DE-FG02-80R5-10226)
(DE81-030950; DOE/R5-10226/1) Avail: NTIS HC A05/MF A01

Progress is reviewed in a project to test the economic feasibility of wind turbine technology for generating electricity. The use of wind genrated electricity on a commercial fruit farm

interconnecting a commercial fruit farm with a major utility to sell power are the find project goals. DOE

N82-11399*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH THERMAL POWER DENSITY HEAT TRANSFER Patent Application
James F. Morris, inventor (to NASA) Filed 30 Oct. 1980 10 p
(NASA-Case-LEW-12950-1; US-Patent-Appl-SN-202228) Avail: NTIS HC A02/MF A01 CSCL 20D

Heat from a high temperature heat pipe is transferred through a vacuum or a gap filled with electrically nonconducting gas to a cooler heat pipe. The heat pipe is used to cool the nuclear reactor while the heat pipe is connected thermally and electrically to a thermionic converter. If the receiver requires greater thermal power density, geometries are used with larger heat pipe areas for transmitting and receiving energy than the area for conducting the heat to the thermionic converter. In this way the heat pipe capability for increasing thermal power densities compensates for the comparatively low thermal power densities through the electrically non-conducting gap between the two heat pipes. NASA

N82-11421# Little (Arthur D.), Inc., Cambridge, Mass.
ASSESSMENT OF I.C. ENGINES AS DRIVERS FOR HEAT ACTUATED HEAT PUMPS
J. C. Burke, W. P. Teagan, and P. G. Goff 1981 6 p Presented at the DOE Heat Pump Contractors' Program Integration Meeting, McLean, Va., 2-4 Jun. 1981 Prepared for ORNL
(Contract W-7405-eng-26)
(DE81-024086; CONF-810672-11) Avail: NTIS HC A02/MF A01

The present suitability and future potential of gas-fired and oil-fired internal combustion (IC) engines for use in heat-actuated heat pumps for space conditioning applications are assessed. Drives for residential and light commercial machines up to 100 KW output or approximately 50 HP engine input are considered. A conceptual design identifying major generic elements was prepared to serve as a basis for estimating performance maintenance costs. A review of prior experiences with IC engines with heat pumps used in similar situations was conducted. Capital costs and maintenance costs were estimated and diesel and spark ignition engine efficiencies were determined. Institutional and operational considerations were identified. DOE

N82-11478# AiResearch Mfg. Co., Torrance, Calif.
BRAYTON/RANKINE 10-TON GAS-FIRED SPACE CONDITIONING SYSTEM, PHASE 2 Annual Report
16 Mar. 1981 103 p refs
(Contracts GRI-5014-341-0114; W-7405-eng-26)
(PB81-223372; GRI-80/0053; ATR-1) Avail: NTIS HC A06/MF A01 CSCL 13I

The heat-actuated space conditioning system provides moe efficient use of natural gas and is intended as an all-gas alternative to the electric heat pump. The system employs a subatmospheric natural-gas-fired heat pump. A centrifugal R-12 refrigerant compressor is driven directly from the Brayton engine rotating group through a hermetically sealed coupling. Unique features that offer high life-cycle performance include a permanent magnet coupling, foil bearings, and atmospheric in-line combustor, and a high-temperature recuperator. Predicted overall engine efficiency is 27 percent and predicted overall coefficient of performane (COP) at the energy source is 1.0 in cooling and 1.2 to 1.4 in heating. GRA

N82-11585# Brown Univ., Providence, R. I.
ANALYSIS OF THERMAL/MECHANICAL ENERGY-CONVERSION CONCEPTS Final Report
R. DiPippo, J. Kestin, and P. F. Maeder Jun. 1981 15 p refs
(Contract DE-AS02-76ET-28320)
(DE81-027854; DOE/ET-28320/48) Avail: NTIS HC A02/MF A01

A list of project activities, meetings, and publications is presented. DOE

N82-11907# Oak Ridge National Lab., Tenn.
ENGINEERING CHALLENGES OF FUSION-REACTOR DEVELOPMENT
Jan B. Talbot 1981 10 p refs Presented at the Soc. of Women Eng. 1981 Natl. Conv., Anaheim, Calif., 24-28 Jun. 1981
(Contract W-7405-eng-26)
(DE81-024129; CONF-810699-1) Avail: NTIS HC A02/MF A01

A brief review of the fusion research program and some problems to be faced in the near future and described. DOE

N82-11934# Mississippi State Univ., Mississippi State. Energy Center.
MAGNETOHYDRODYNAMIC RESEARCH PROGRAM OF THE MHD ENERGY CENTER AT MISSISSIPPI STATE UNIVERSITY AND STRUCTURAL FEATURES OF MHD RADIANT BOILERS
W. S. Shepard 1981 53 p Lectures presented to MHD/HRSR Sci. and Engr. of the Peoples Republic of China, 10-31 Jul. 1981
(Contract DE-AC02-80ET-15601)
(DE81-029901; DOE/ET-15601/T3; TR-3) Avail: NTIS HC A04/MF A01

Magnetohydrodynamic is conducted largely through use of test stand which simulates conditions in the MHD gas stream. Continual modification of the test stand to reflect experimental results produced a test stand capable of test runs of 100 hours; runs of more than 500 hours are planned. The test stand is described, and experimental results are discussed. The design and construction of MHD radiant boiler are described. The radiant furnance serves several functions in a heat recovery and seed recovery system; it cools flue gases to a temperature suitable for entrance to the secondary superheater; it generates steam; it provides for the removal of molten ash at high temperatures; and it provides access for intrusive and nonintrusive instrumentation to the gas-side environment. DOE

N82-11935# Massachusetts Inst. of Tech., Cambridge. Plasmas Fusion Center.
RF-DRIVEN TOKAMAK REACTOR WITH SUB-IGNITED, THERMALLY STABLE OPERATION
L. P. Harten, A. Bers, V. Fuchs, (IREQ, Varennes, Canada), and M. M. Shoucri, (IREQ, Varennes, Canada) Feb. 1981 9 p refs Presented at the 4th Topical Conf. on RF Heating of Plasma, Austin, Tex., Feb. 1981
(Contract DE-AC02-76ET-51013)
(DE81-029437; DOE/ET-51013/8; PFC/RR-81-6) Avail: NTIS HC A02/MF A01

A Radio-Frequency Driven Tokamak Reactor (RFDTR) can use RF-Power, programmed by a delayed temperature measurement, to thermally stabilize a power equilibrium below ignition, and to drive a steady state current. We propose the parameters for such a device generating approx. = 1600 MW thermal power and operating with Q approx. = 40 (= power out/power in). A one temperature zero-dimensional model allows simple analytical formulation of the problem. The relevance of injected impurities for locating the equilibrium is discussed. We present the results of a one-dimensional (radial) code which includes the deposition of the supplementary power, and compare with out zero-dimensional model. DOE

N82-11944# Los Alamos Scientific Lab., N. Mex.
UNCERTAINTIES ASSOCIATED WITH INERTIAL-FUSION IGNITION
Gene H. McCall 1981 10 p refs Presented at the Conf. on Optics, Santa Fe, N. Mex., Apr. 1981
(Contract W-7405-eng-36)
(DE81-025408; LA-UR-81-1750; CONF-81-429-34) Avail: NTIS HC A02/MF A01

An estimate is made of a worst case driving energy which is derived from analytic and computer calculations. The uncertainty can be reduced by a factor of 10 to 100 if certain physical effects are understood. That is not to say that the energy requirement can necessarily be reduced below that of the worst case, but it is possible to reduce the uncertainty associated with ignition energy. With laser costs in the $0.5 to 1 billion per MJ range, it can be seen that such an exercise is worthwhile. DOE

N82-11947# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
DEVELOPMENT, TESTING, AND EVALUATION OF MHD MATERIALS AND COMPONENT DESIGNS. VOLUME 1: EXECUTIVE SUMMARY Final Report, 15 Oct. 1973 - 31 Dec. 1975
W. E. Young Nov. 1980 44 p refs
(Contract DE-AC01-76ET-10805)

(DE81-026203; DOE/ET-10805/T1-Vol-1; FE-1540-29-Vol-1) Avail: NTIS HC A03/MF A01

Results of studies on gas electrical properties, coal combustion, and MHD materials intended to support the Waltz Mill channel experiments are presented. Materials testing indicated that stabilized zirconia should be an acceptable electrode material. Cyclone coal combustors were studied and designs developed for a Waltz Mill size unit and a 25,000 lb/h prototype. The Waltz Mill facility performed in a highly satisfactory manner. Six non generating and 16 load tests were made on three channels. Following a failure of the air heater tests were run essentially on materials and structure. The system was dismantled and reconstruction started to enable testing at the proposed Component Development Integrated Facility. A very successful 127-hour run was made on a pair of US designed and constructed MHD electrode modules in the Soviet Union's U-02 facility. DOE

N82-11993*# Resor Associates, Inc., Sunnyvale, Calif.
JET IMPINGEMENT HEAT TRANSFER ENHANCEMENT FOR THE GPU-3 STIRLING ENGINE
Douglas C. Johnson, Craig W. Congdon, Lester L. Begg, Edward J. Britt, and Lanny G. Thieme Oct. 1981 28 p refs
(NASA-TM-82727; DOE/NASA/51040/33) Avail: NTIS HC A03/MF A01 CSCL 13F

A computer model of the combustion-gas-side heat transfer was developed to predict the effects of a jet impingement system and the possible range of improvements available. Using low temperature (315 C (600 F)) pretest data in an updated model, a high temperature silicon carbide jet impingement heat transfer system was designed and fabricated. The system model predicted that at the theoretical maximum limit, jet impingement enhanced heat transfer can: (1) reduce the flame temperature by 275 C (500 F); (2) reduce the exhaust temperature by 110 C (200 F); and (3) increase the overall heat into the working fluid by 10%, all for an increase in required pumping power of less than 0.5% of the engine power output. Initial tests on the GPU-3 Stirling engine at NASA-Lewis demonstrated that the jet impingement system increased the engine output power and efficiency by 5% - 8% with no measurable increase in pumping power. The overall heat transfer coefficient was increased by 65% for the maximum power point of the tests. A.R.H.

N82-12444*# Chrysler Corp., Detroit, Mich.
AGT-102 AUTOMOTIVE GAS TURBINE Summary Report
Jun. 1981 434 p refs Sponsored by NASA. Lewis Research Center Prepared jointly with Williams Research Corp., Walled Lake, Mich.
(Contract DE-AC02-76CS-52749)
(NASA-CR-165353; DOE/NASA/2749-81/1) Avail: NTIS HC A19/MF A01 CSCL 13I

Development of a gas turbine powertrain with a 30% fuel economy improvement over a comparable S1 reciprocating engine, operation within 0.41 HC, 3.4 CO, and 0.40 NOx grams per mile emissions levels, and ability to use a variety of alternate fuels is summarized. The powertrain concept consists of a single-shaft engine with a ceramic inner shell for containment of hot gasses and support of twin regenerators. It uses a fixed-geometry, lean, premixed, prevaporized combustor, and a ceramic radial turbine rotor supported by an air-lubricated journal bearing. The engine is coupled to the vehicle through a widerange continuously variable transmission, which utilizes gearing and a variable-ratio metal compression belt. A response assist flywheel is used to achieve acceptable levels of engine response. The package offers a 100 lb weight advantage in a Chrysler K Car front-wheel-drive installation. Initial layout studies, preliminary transient thermal analysis, ceramic inner housing structural analysis, and detailed performance analysis were carried out for the basic engine. S.L.

N82-12448*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MAGNETOHYDRODYNAMICS (MHD) ENGINEERING TEST FACILITY (ETF) 200 MWe POWER PLANT. DESIGN REQUIREMENTS DOCUMENT (DRD) Final Report
H. S. Rigo, R. W. Bercaw, J. A. Burkhart, T. S. Mroz, D. J. Bents, and A. M. Hatch (MIT) Sep. 1981 88 p refs Revised
(Contract DE-AI01-77ET-10769)
(NASA-TM-82705; DOE/NASA/10769-20-Rev-3) Avail: NTIS HC A05/MF A01 CSCL 10B

A description and the design requirements for the 200 MWe (nominal) net output MHD Engineering Test Facility (ETF) Conceptual Design, are presented. Performance requirements for the plant are identified and process conditions are indicated at interface stations between the major systems comprising the plant. Also included are the description, functions, interfaces and requirements for each of these major systems. The lastest information (1980-1981) from the MHD technology program are integrated with elements of a conventional steam electric power generating plant. M.D.K.

N82-12537# Aeronautical Research Inst. of Sweden, Stockholm.
A TWO-DIMENSIONAL STUDY OF THE MAXIMUM POWER THAT CAN BE OBTAINED FROM A WIND TURBINE IN A WIND SHEAR LAYER
Bo C. A. Johansson Apr. 1981 60 p refs
(FFA-134) Avail: NTIS HC A04/MF A01

A two dimensional study, where the undisturbed velocity field is given and allowed to vary arbitrarily vertically, and the location of the wind turbine is given, is presented. The maximum power is calculated by the method of calculus of variations. The maximum power of common wind velocity profiles is only slightly larger than the power, which is obtained by a constant relative wind speed retardation, while for a linear velocity profile there is a considerable difference. S.L.

N82-12570*# Gilbert/Commonwealth, Reading, Pa.
MAGNETOHYDRODYNAMICS (MHD) ENGINEERING TEST FACILITY (ETF) 200 MWe POWER PLANT. CONCEPTUAL DESIGN ENGINEERING REPORT (CDER). VOLUME 1: EXECUTIVE SUMMARY Final Report
Sep. 1981 48 p
(Contracts DEN3-224; DE-AI01-77ET-10769)
(NASA-CR-165452-Vol-1; DOE/NASA-0224/1-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 10B

Main elements of the design are identified and explained, and the rationale behind them was reviewed. Major systems and plant facilities are listed and discussed. Construction cost and schedule estimates are presented, and the engineering issues that should be reexamined are identified. The latest (1980-1981) information from the MHD technology program is integrated with the elements of a conventional steam power electric generating plant. T.M.

N82-12572*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
LOW NO SUB X HEAVY FUEL COMBUSTOR CONCEPT PROGRAM Final Report, 23 Oct. 1979 - Jul. 1981
Paul Russell, George Beal, and Bruce Hinton 15 Oct. 1981 99 p refs Prepared in cooperation with Pratt and Whitney Aircraft, East Hartford, Conn.
(Contracts DEN3-149; DE-AI01-77ET-13111)
(NASA-CR-165512; DOE/NASA/0149-1; QTR-3236) Avail: NTIS HC A05/MF A01 CSCL 10B

A gas turbine technology program to improve and optimize the staged rich lean low NOx combustor concept is described. Subscale combustor tests to develop the design information for optimization of the fuel preparation, rich burn, quick air quench, and lean burn steps of the combustion process were run. The program provides information for the design of high pressure full scale gas turbine combustors capable of providing environmentally clean combustion of minimally of minimally porcessed and synthetic fuels. It is concluded that liquid fuel atomization and mixing, rich zone stoichiometry, rich zone liner cooling, rich zone residence time, and quench zone stoichiometry are important considerations in the design and scale up of the rich lean combustor. E.A.K.

N82-12590# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SECURITY ASSESSMENT OF POWER SYSTEMS INCLUDING ENERGY STORAGE AND WITH THE INTEGRATION OF WIND ENERGY Progress Report, 1 Apr. - 30 Jun. 1981
D. P. Carroll and P. C. Krause Jul. 1981 17 p
(Contracts DE-AS02-77ET-29100; EC-77-S-02-4206)
(DE81-030166; DOE/ET-29100/T1) Avail: NTIS HC A02/MF A01

Methods of Resynchronizing wind turbine generators, and performance of wind turbines in a turbulent atmosphere, were discussed. The work on reduced order modeling by SEPI is reported. Aggregation techniques which have been formulated are validated. DOE

N82-12591# Sandia Labs., Albuquerque, N. Mex. Advanced Energy Project Div.
VERTICAL-AXIS WIND-TURBINE CONTROL STRATEGY
Gerald M. McNerney Aug. 1981 21 p refs
(Contract DE-AC04-76DP-00789)
(DE81-031932; SAND-81-1156) Avail: NTIS HC A02/MF A01

Early expense in automatic operation of the Sandia 17-m vertical axis research wind turbine (VAWT) demonstrated the need for a systematic study of control algorithms. To this end, a computer model was developed that uses actual wind time series and turbine performance data to calculate the power produced by the Sandia 17-m VAWT operating in automatic control. The model was used to investigate the influence of starting algorithms on annual energy production. The results indicate that, depending on turbine and local wind characteristics, a bad choice of a control algorithm can significantly reduce overall energy production. The model can be used to select control algorithms and threshold parameters that maximize long-term energy production. DOE

N82-12592# COECORP, Mountain View, Calif.
INVESTIGATION AND RESEARCH OF SPECIFIC COMBUSTION-TURBINE AND COMBINED-CYCLE FIELD PROBLEMS Annual Report
Aug. 1981 62 p Prepared in cooperation with Aptech Engineering Services, Inc. Sponsored by Electric Power Research Inst.
(EPRI Proj. 1802)
(DE81-904231; EPRI-AP-1981) Avail: NTIS HC A04/MF A01

Specific combustion turbine and combined cycle field problems are discussed. These are (1) fuel filter plugging, (2) apparent compressor surge, (3) oily waste water, (4) compressor wheel failure, and (5) combustor problems. Results of research efforts are outlined. DOE

N82-12634# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
INNOVATIVE EQUIPMENT FOR SMALL-SCALE HYDRO DEVELOPMENTS
J. D. Lawrence and Leslie Pereira 1981 17 p refs Presented at the Waterpower Conf., Washington, D.C., 22 Jun. 1981 Prepared in cooperation with Acres American, Inc., Buffalo, N.Y.
(Contract DE-AC07-76ID-01570)
(DE81-027820; EGG-M-03381; CONF-8106137-4) Avail: NTIS HC A02/MF A01

The feasibility of using off the shelf pumps as turbines, with induction motors as generators, and combinations of available equipment such as speed increasers, inlet valves, and gates for typical small scale hydro installations are discussed. A computer simulation model was developed in the study which provides a basis to estimate the performance of pumps in the turbine mode of operation. It is indicated that a major part of the small hydro plant potential can be economically covered by the use of pumps as turbines and induction motors as generators especially for the smaller ratings. DOE

N82-12648# Joint Publications Research Service, Arlington, Va.
GERMAN-ARGENTINE EXPERIMENT: VERTICAL-ROTOR WIND ENGINE
Peter Raabe *In its* W. Europe Rept.: Sci. and Technol., No. 72 (JPRS-78876) 1 Sep. 1981 p 18-19 Transl. into ENGLISH from Tagesspiegel (Berlin), 4 Jul. 1981 p 12

Avail: NTIS HC A03/MF A01

Designed by aerodynamists, a wind motor built in Patagonia, is independent of the direction of the wind due to its vertical rotating axis. The narrow rotor blades have optimum aerodynamic efficiency. Drum-like wind collectors at the top and bottom of the rotating axis serve as starters. The plant incorporates simple instead of sophisticated mechanical parts, and its maintenance requirements are extremely low. Only the two rotating bearings located at the top and bottom of the axis require lubrication, with the oil being changed only twice a year. A.R.H.

N82-12943*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
END REGION AND CURRENT CONSOLIDATION EFFECTS UPON THE PERFORMANCE OF AN MHD CHANNEL FOR THE ETF CONCEPTUAL DESIGN
S. Y. Wang and J. Marlin Smith [1981] 9 p refs To be presented at the 20th Aerospace Sci. Conf., Orlando, Fla., 11-14 Jan. 1982; sponsored by AIAA
(Contract DE-AI01-77ET-10769)
(NASA-TM-82744; DOE/NASA/10769-22; E-1057) Avail: NTIS HC A02/MF A01 CSCL 20I

The effects of MHD channel end regions on the overall power generation were considered. The peak plant thermodynamic efficiency was found to be slightly lower than for the active region (41%). The channel operating point for the peak efficiency was shifted to the supersonic mode (Mach No., M sub c approx. 1.1) rather than the previous subsonic operation (M sub c approx. 0.9). The sensitivity of the channel performance to the B-field, diffuser recovery coefficient, channel load parameter, Mach number, and combustor pressure is also discussed. In addition, methods for operating the channel in a constant-current mode are investigated. This mode is highly desirable from the standpoint of simplifying the current and voltage conditioning for the inverter system. This simplification could result in significant savings in the cost of the equipment. The initial results indicate that this simplification is possible, even under a strict Hall field constraint, with reasonable plant thermodynamic efficiency (40.5%) N.W.

N82-13013*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEST RESULTS AND FACILITY DESCRIPTION FOR A 40-KILOWATT STIRLING ENGINE Final Report
Gary G. Kelm, James E. Cairelli, and Robert J. Walter Jun. 1981 47 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-82620; DOE/NASA/51040-27; E-871) Avail: NTIS HC A03/MF A01 CSCL 10B

A 40 kilowatt Stirling engine, its test support facilities, and the experimental procedures used for these tests are described. Operating experience with the engine is discussed, and some initial test results are presented S.L.

N82-13114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF ROTOR BLADE THICKNESS AND SURFACE FINISH ON THE PERFORMANCE OF A SMALL AXIAL FLOW TURBINE
Richard J. Roelke and Jeffrey E. Haas 1982 13 p refs Proposed for presentation at the Gas Turbine Ann. Meeting, London, 18-22 Apr. 1982; sponsored by ASME Prepared in cooperation with Army Aviation Research and Development Command, Cleveland
(Contract DE-AI01-77CS-51040)
(NASA-TM-82726; DOE/NASA/51040-34; TR-81-C-29) Avail: NTIS HC A02/MF A01 CSCL 21E

An experimental investigation was conducted to determine the effect of blade profile inaccuracies and surface finish on the aerodynamic performance of a 11.13 cm tip diameter turbine. The as-received cast rotor blades had a significantly thicker profile than the design intent and a fairly rough surface finish. Stage test results showed an increase of one point in efficiency by smoothing the surface finish and another three points by thinning the blade profiles to near the design profile. Most of the performance gain between the as-cast thick and the thinned rotor blades both with the same surface finish, was attributed to reduced trailing edge losses of the recontoured blades Author

N82-13367# Tennessee Univ. Space Inst., Tullahoma. Energy Conversion Div.
TWO-DIMENSIONAL EFFECTS IN POWER TAKE-OFF REGION
M. Isnikawa and Y. C. L. Wu May 1981 29 p refs
(Contract DE-AC02-79ET-10815)
(DE82-000091; DOE/ET-10815/55) Avail: NTIS HC A03/MF A01

A two-dimensional analytical model of the power take-off (PTO) region of a diagonal conducting wall MHD generator is presented and compared with experimental results. Reasonable agreement was found in both voltage and current distributions from the two-dimensional analysis, while similar comparison of experimental data with one-dimensional calculations with experiments was not satisfactory. Power take-off from mid-channel was also investigated. It was found that larger current was carried by these electrodes. In addition, large circulating current was found in the sidewalls resulting from diagonalization. Therefore ballast resistors are required to equalize the current. A general PTO resistor design was proposed. Trade-off considerations

between power output and protection of over-current were made. DOE

N82-13386*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF A FLUIDIC POWER GENERATOR
V. Serohia, L. Bernal, and R. B. Beauchamp 15 Nov. 1981 81 p refs
(Contract NAS7-100)
(JPL-Pub-81-100) Avail: NTIS HC A05/MF A01 CSCL 20D

A combined experimental and analytical investigation was performed to understand the various fluid processes associated with the conversion of flow energy into electric power in a fluidic generator. Experiments were performed under flight-simulated laboratory conditions and results were compared with those obtained in the free-flight conditions. It is concluded that the mean mass flow critically controlled the output of the fluidic generator. Cross-correlation of the outputs of transducer data indicate the presence of a standing wave in the tube; the mechanism of oscillation is an acoustic resonance tube phenomenon. A linearized model was constructed coupling the flow behavior of the jet, the jet-layer, the tube, the cavity, and the holes of the fluidic generator. The analytical results also show that the mode of the fluidic power generator is an acoustical resonance phenomenon with the frequency of operation given by f approx = a/4L, where f is the frequency of jet swallowing, a is the average speed of sound in the tube, and L is the length of the tube. Analytical results further indicated that oscillations in the fluidic generator are always damped and consequently there is a forcing of the system in operation.
M.D.K.

N82-13451# California Univ., Los Angeles. School of Engineering and Applied Science.
ASYMMETRIC STRESS AND FAILURE ANALYSIS
J. Yu and R. Westmann [1981] 6 p refs
(Contract DE-AT03-76SF-74016)
(DE81-026842; DOE/SF-74016/T3) Avail: NTIS HC A02/MF A01

The cladding failure due to asymmetric structural response of the fuel cell is studied. The fracture and cracking patterns prior to the development of fuel-cladding contact and the forces in the cladding after fuel-cladding contact has been made are investigated.
DOE

N82-13490*# Engelhard Industries, Inc., Edison, N.J.
DEVELOP AND TEST FUEL CELL POWERED ON-SITE INTEGRATED TOTAL ENERGY SYSTEM. PHASE 3: FULL-SCALE POWER PLANT DEVELOPMENT Quarterly Report, Feb. - Apr. 1981
A. Kaufman 24 Jun. 1981 50 p
(Contract DEN3-241)
(NASA-CR-165328; DOE/NASA/0241-1; QR-1) Avail: NTIS HC A03/MF A01 CSCL 10B

An integrated 5 kW power system based upon methanol fuel and a phosphoric acid fuel cell operating at about 473 K is described. Description includes test results of advanced fuel cell catalysts, a semiautomatic acid replenishment system and a completed 5 kW methanol/system reformer. The results of a preliminary system test on a reformer/stack/inverter combination are reported. An initial design for a 25 kW stack is presented. Experimental plans are outlined for data acquisition necessary for design of a 50 kW methanol/steam reformer. Activities related to complete mathematical modelling of the integrated power system, including wasteheat utilization, are described.
E.A.K.

N82-13507*# Case Western Reserve Univ., Cleveland, Ohio.
TRANSIENT CATALYTIC COMBUSTOR MODEL Final Report
James S. Tien May 1981 87 p refs
(Grant NsG-3230; Contract DE-AI01-77CS-51040)
(NASA-CR-165324; DOE/NASA/3230-1) Avail: NTIS HC A05/MF A01 CSCL 10B

A quasi-steady gas phase and thermally thin substrate model is used to analyze the transient behavior of catalytic monolith combustors in fuel lean operation. The combustor response delay is due to the substrate thermal inertia. Fast response is favored by thin substrate, short catalytic bed length, high combustor inlet and final temperatures, and small gas channel diameters. The calculated gas and substrate temperature time history at different axial positions provides an understanding of how the catalytic combustor responds to an upstream condition change. The computed results also suggest that the gas residence times in the catalytic bed in the after bed space are correlatable with the nondimensional combustor response time. The model also performs steady state combustion calculations; and the computed steady state emission characteristics show agreement with available experimental data in the range of parameters covered. A catalytic combustor design for automotive gas turbine engine which has reasonably fast response (< 1 second) and can satisfy the emission goals in an acceptable total combustor length is possible.
S.L.

N82-13510*# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.
DEVELOPMENT OF A HIGH-TEMPERATURE DURABLE CATALYST FOR USE IN CATALYTIC COMBUSTORS FOR ADVANCED AUTOMOTIVE GAS TURBINE ENGINES Final Report
H. Tong, G. C. Snow, E. K. Chu, R. L. S. Chang, M. J. Angwin, and S. L. Pessagno Sep. 1981 169 p refs
(Contracts DEN3-83; DE-AI01-77CS-51040)
(NASA-CR-165396; DOE/NASA/0083-1) Avail: NTIS HC A08/MF A01 CSCL 10B

Durable catalytic reactors for advanced gas turbine engines were developed. Objectives were: to evaluate furnace aging as a cost effective catalytic reactor screening test, measure reactor degradation as a function of furnace aging, demonstrate 1,000 hours of combustion durability, and define a catalytic reactor system with a high probability of successful integration into an automotive gas turbine engine. Fourteen different catalytic reactor concepts were evaluated, leading to the selection of one for a durability combustion test with diesel fuel for combustion conditions. Eight additional catalytic reactors were evaluated and one of these was successfully combustion tested on propane fuel. This durability reactor used graded cell honeycombs and a combination of noble metal and metal oxide catalysts. The reactor was catalytically active and structurally sound at the end of the durability test.
E.A.K.

N82-13515# Electric Power Research Inst., Palo Alto, Calif. Steam Generator Project Office.
WORKSHOP PROCEEDINGS: U-BEND TUBE CRACKING IN STEAM GENERATORS
Carl E. Shoemaker, ed. Jun. 1981 343 p refs Workshop held at Denver, 20-21 Aug. 1980
(DE81-903765; EPRI-WS-80-136; CONF-8008122) Avail: NTIS HC A15/MF A01

A design to reduce the rate of tube failure in high pressure feedwater heaters, a number of failed drawn and stress relieved Monel 400 U-bend tubes removed from three high pressure feedwater heaters was examined. Steam extracted from the turbine is used to preheat the boiler feedwater in fossil fuel fired steam plants to improve thermal efficiency. This is accomplished in a series of heaters between the condenser hot well and the boiler. The heaters closest to the boiler handle water at high pressure and temperature. Because of the severe service conditions, high pressure feedwater heaters are frequently tubed with drawn and stress relieved Monel 400.
DOE

N82-13519# Oregon State Univ., Corvallis. Dept. of Atmospheric Science.
WIND POWER: RESEARCH ON NETWORK WIND POWER OVER THE PACIFIC NORTHWEST. EXECUTIVE SUMMARY Progress Report, Oct. 1979 - Sep. 1980
R. W. Baker and E. W. Hewson Oct. 1980 23 p refs
(DE81-029360; DOE/BP-58) Avail: NTIS HC A02/MF A01

The research in FY-80 is composed of six primary tasks. These tasks include data collection and analysis, wind flow studies around an operational wind turbine generator (WTG), kite anemometer calibration, wind flow analysis and prediction, the Klickitat County small wind energy conversion system (SWECS) program, and network wind power analysis. The data collection and analysis task consists of four sections, three of which deal with wind flow site surveys and the fourth with collecting and analyzing wind data from existing data stations.
DOE

N82-13528# South Carolina Energy Research Inst., Columbia.
RESIDUAL-ENERGY-APPLICATION PROGRAM: EAST FACILITY REQUIREMENTS DOCUMENT, VOLUME 1
P. W. Yngve, F. H. Zander, and F. J. McCrosson 31 Jul. 1981 85 p refs

(Contract DE-AC09-77ET-12868)
(DE81-027536; DOE/ET-12868/8-Vol-1) Avail: NTIS HC A05/MF A01

The objectives of the EAST Facility are to perform research and development on heat energy recovery and conversion equipment; establish high confidence in system performance, system availability, and system operating, maintenance, and material costs; and provide a national competence in technologies required for the installation and operation of heat recovery systems. An initial testing capability recommended for EAST is presented and design specifications are provided for the physical plant and major test support systems. Five options are included for tailoring the full-up testing capability to reduce costs of the core facility. T.M.

N82-13550 Stanford Univ., Calif.
ELECTRICAL EFFECTS OF SLAG IN A DIFFUSE MODE MAGNETOHYDRODYNAMIC GENERATOR Ph.D. Thesis
Ron Michael Nelson 1981 181 p
Avail: Univ. Microfilms Order No. 8124118

A high temperature (1900 K) platinum-rhodium capped magnesia electrode was developed and successfully tested in a slagging MHD generator. Diffuse mode (non-arcing) operation of high temperature anodes was achieved at current densities up to 3 amps sq cm2. The problem of cathode shorting caused by the ionic nature of slag electrical conductivity (with iron as the major mobile species) was not substantially alleviated by high temperature operation. A computer code was developed which solves the governing electrical equations along with slag energy and thickness equations for a two dimensional, periodic electrode pair in a slagging MHD generator. The numerical results compare favorably with the experimental results including cases with shorted cathode walls. The computer model was used to assess the effects of slag and other operating parameters on generator performance. Dissert. Abstr.

N82-13926# Mississippi State Univ., Mississippi State. MHD Energy Center.
TESTING AND EVALUATION OF MHD MATERIALS AND SUBSTRUCTURES Final Technical Report, Apr. 1976 - Jun. 1981
Jun. 1981 204 p refs
(Contract DE-AC01-78ET-10785)
(DE81-024331; DOE/ET-10785/T1) Avail: NTIS HC A10/MF A01

Stand that can simulate the environment in any of the various substructures of a coal fired baseline MHD power plant. After construction was completed, shakedown tests were performed, and the Test Stand was used in a series of tests to simulate the gas stream composition and temperature conditions in the baseline plant's radiant boiler. The tests were conducted in order to study the effect of stoichiometry and staged combustion on the generation of nitrogen oxide. A computer based monitoring and control system was developed that provides safe Test Stand operation, controls the critical parameters, and accurately measures, displays, and logs the necessary physical data. Several computer programs were developed to determine the thermal performance of the Test Stand, and several models were developed to predict the thermal performance of the Test Stand with bare walls and with slag coated walls, and to determine the gas stream properties as a function of temperature and pressure. DOE

N82-13963# Galaxy, Inc., Washington, D.C.
UPDATE ON SPECIFIED EUROPEAN R AND D EFFORTS. PART 1: APPENDICES
Oct. 1980 117 p Partly in ENGLISH; partly in GERMAN
(Contract DE-AC03-79SF-10538)
(DE81-026404; DOE/SF-10538/T10) Avail: NTIS HC A06/MF A01

Progress and update on specified European R and D are reported. The following topics are discussed: blueburner test with different swirl spray nozzles, aerodynamics of a flat nonswirl blue flame, and large industrial blue flame burners, manufacturer's design and performance literature for the 2500 to 3500 KW KG5 gas turbine, the Kongsberg 1500 to 2000 kVA generating set, the 500 to 700 kVA generating set, the KG 831 gas turbine generating set, the KG 2 gas turbine, and selection criteria for gas turbines for emergency power supplies; and high temperature corrosion and carburization and silicon coatings as high temperature corrosion protection for gas turbine blades. DOE

N82-14520# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
CONCEPTUAL DESIGN OF SUPERCONDUCTING MAGNET SYSTEM FOR MAGNETOHYDRODYNAMIC (MHD) ENGINEERING TEST FACILITY (ETF) 200 MWe POWER PLANT Final Report
Nov. 1981 259 p refs
(Grant NAG3-100)
(NASA-CR-165053; FBNML-NAS-E-2) Avail: NTIS HC A12/MF A01 CSCL 14B

A super conducting magnet system conceptual design to meet the requirements of a magnetohydrodynamic test facility power train is presented. A detailed description of the magnet is accompanied by numerous engineering drawings. Functional requirements, system interfaces, and design criteria are reviewed. System limits, safety precautions, operational procedures, and maintenance procedures are discussed. R.J.F.

N82-14633*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ALUMINUM BLADE DEVELOPMENT FOR THE MOD-0A 200-KILOWATT WIND TURBINE Final Report
Bradford S. Linscott, Richard K. Shaltens, and A. G. Eggers (Westinghouse Electric Corp., Pittsburg) Dec. 1981 43 p refs
(Contract DE-AB29-76ET-20370)
(NASA-TM-82594; DOE/NASA-20370/20) Avail: NTIS HC A03/MF A01 CSCL 10A

The rotor blade configuration, fabrication methods, analyses, operating experience, design modifications, and cost are described. Each 60-ft.-(18.3-m-) long aluminum blade used current aircraft fixed wing and rotary wing design and fabrication technologies. Structural damage, repairs, and modifications that occurred during 6500 hours of operation are summarized. T.M.

N82-14642# United Technologies Corp., South Windsor, Conn. Power Systems Div.
INVESTIGATION OF THE IN-SITU OXIDATION OF METHANOL IN FUEL CELLS Final Report, Jun. 1980 - May 1981
D. A. Landsman and F. J. Luczak Sep. 1981 32 p refs
(Contract DAAK70-80-C-0049; DA Proj. 1L1-61102-AH-51)
(AD-A105647; FCR-3483) Avail: NTIS HC A03/MF A01 CSCL 10/2

Direct anodic oxidation and internal reforming were examined as ways of using methanol as fuel in a phosphoric acid fuel cell. The literature was reviewed to identify the most effective catalysts for the direct electrochemical oxidation of methanol. It is shown that, even with the best of these catalysts, anode polarization at practical current densities is 300 mV higher on methanol than on hydrogen. It was also found that unreacted methanol which diffuses across the cell can cause severe polarization of the cathode. Theoretical and experimental studies of internal reforming showed that a fuel cell will generate sufficient waste heat to sustain the methanol steam reforming reaction. Thus, thermally integrated, internal reforming is a feasible alternative to external reforming. The reforming catalyst is preferably located in separate chambers built into the stack, since this prevents phosphoric acid from attacking the reforming catalyst and methanol from migrating to the cathode. Author (GRA)

N82-14666# Bonn Univ. (West Germany). Inst. fuer Physikalische Chemie.
ELECTRODES AND DIAPHRAGMS FOR FUEL CELLS Final Report, Dec. 1979
Wolf Vielstich and Ernst Knauf Bundesministerium fuer Forschung und Technologie Feb. 1981 45 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-047; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9.50

Nickel whisker electrodes with variations in network structure, pore size, and metal coatings were produced for use in water electrolytic cells and fuel cells. The resistance due to gas bubbles was decreased considerably by slits milled into the electrode. Platinization was optimized for use in glycol/air cells and glycol anodes with constantly good anode potentials were obtained with whisker structures by standardization of the platinization process. It is concluded that the activity of the glycol anodes depends strongly on the procedure of deposition of the noble metals and less on the whisker structure as such. Author (ESA)

N82-15454# Los Alamos Scientific Lab., N. Mex.
FAILURE MODE ANALYSIS USING STATE VARIABLES DERIVED FROM FAULT TREES WITH APPLICATION
Robert J. Bartholomew 1981 11 p refs Presented at the ANS/ENS Topical Meeting on Probabilistic Risk Assessment, Port Chester, N.Y., 20-24 Sep. 1981
(Contract W-7405-eng-36)
(DE81-030238; LA-UR-81-2595; CONF-810905-3) Avail: NTIS HC A02/MF A01

Fault Tree Analysis (FTA) is used extensively to assess both the qualitative and quantitative reliability of engineered nuclear power systems employing many subsystems and components. FTA is very useful, but the method is limited by its inability to account for failure mode rate of change interdependencies (coupling) of statistically independent failure modes. The state variable approach (using FTA derived failure modes as states) overcomes these difficulties and is applied to the determination of the lifetime distribution function for a heat pipe thermoelectric nuclear power subsystem. Analyses are made using both Monte Carlo and deterministic methods and compared with a Markov model of the same subsystem. DOE

N82-15527*# Burns and Roe, Inc., Woodbury, N. Y.
MHD OXIDANT INTERMEDIATE TEMPERATURE CERAMIC HEATER STUDY Final Report
A. W. Carlson, I. L. Chait, D. P. Saari, and C. L. Marksberry Sep. 1981 199 p refs Prepared in cooperation with Fluidyne Engineering Corp.
(Contract DEN3-107; DE-AI01-77ET-10769)
(NASA-CR-165463; DOE/NASA-0107/3) Avail: NTIS HC A09/MF A01 CSCL 10A

The use of three types of directly fired ceramic heaters for preheating oxygen enriched air to an intermediate temperature of 1144K was investigated. The three types of ceramic heaters are: (1) a fixed bed, periodic flow ceramic brick regenerative heater; (2) a ceramic pebble regenerative heater. The heater design, performance and operating characteristics under conditions in which the particulate matter is not solidified are evaluated. A comparison and overall evaluation of the three types of ceramic heaters and temperature range determination at which the particulate matter in the MHD exhaust gas is estimated to be a dry powder are presented. E.A.K.

N82-15681# Sandia Labs., Albuquerque, N. Mex.
PROJECT DEEP STEAM: FOURTH MEETING OF THE TECHNICAL ADVISORY PANEL
R. L. Fox, A. B. Donaldson, S. W. Eisenhawer, C. M. Hart, D. R. Johnson, A. J. Mulac, J. R. Wayland, and L. J. Weirick Jul. 1981 104 p Proceedings of Meeting held at Albuquerque, N.Mex., 4-5 Nov. 1980
(Contract DE-AC04-76DP-00789)
(DE81-029457; SAND-81-0043) Avail: NTIS HC A06/MF A01

The status of project DEEP STEAM was reviewed. Proceedings, are divided into five main sections: (1) the injection string modification program; (2) the downhole steam generator program; (3) supporting activities; (4) field testing; and (5) recommendations and discussion. DOE

N82-15680# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
OVERVIEW AND FY 1981 PROGRESS ON OPEN-CYCLE OTEC POWER SYSTEMS
T. R. Penney and B. Shelpuk Aug. 1981 7 p refs Presented at the Oceans Conf., Boston, 19-21 Sep. 1981
(Contract EG-77-C-01-4042)
(DE81-029277; SERI/TP-634-1282; CONF-810911-3) Avail: NTIS HC A02/MF A01

Progress in an advanced research and development program studying viable alternatives to closed cycle OTEC is reported. Work on a 100 MWe steam turbine, heat exchangers, and deaeration for Claude or open cycle OTEC systems are reported. Capsule descriptions of ocean energy conversion techniques are given, including wave energy conversion, ocean current energy conversion, and salinity gradient energy conversion as well as varieties of ocean thermal energy conversion. DOE

N82-15893# Department of Energy, Washington, D. C. Office of Energy Research.
TECHNOLOGY OF CONTROLLED NUCLEAR FUSION
F. H. Tenney, ed. and C. C. Hopkins, ed. Jul. 1981 644 p refs Proceedings of the 4th ANS Topical Meeting held at King of Prussia, Pa., 14-17 Oct. 1980 Sponsored in part by DOE, Washington, D.C. and EPRI
(DE81-027361; CONF-801011-Vol-3) Avail: NTIS HC A99/MF A01

An assessment of magnetically confined fusion power reactors, their technological use and applications, is made. The key engineering areas studied relate to: thermomechanics, thermohydraulics, electromagnetics, nucleonics, systems engineering, assembly, maintenance, repair, instrumentation and control of reactors and reactor materials. The subjects of safety factors, laser applications, and wall design are also addressed. M.D.K.

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ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission.

A82-10806 **Heat Transfer - Milwaukee 1981; Proceedings of the Twentieth National Heat Transfer Conference, Milwaukee, WI, August 2-5, 1981.** Conference sponsored by the American Institute of Chemical Engineers and American Society of Mechanical Engineers. Edited by R. P. Stein (Argonne National Laboratory, Argonne, IL). *AIChE Symposium Series*, vol. 77, no. 208, 1981. 435 p.

Aspects of direct contact heat transfer are considered along with transport phenomena in fusion reactors, enhanced nucleate boiling, flow boiling, heat transfer in non-Newtonian systems, two-phase systems, heat transfer in fossil fuel conversion systems, process heat transfer, thermal and hydraulic behavior in rod and tube bundles, and two-phase systems in rod and tube bundles. Attention is also given to solar energy heat transfer, heat transfer in fluidized beds, and fire and combustion fundamentals, taking into account thermal stress oscillations induced by dynamic instabilities in radiation-heated boiler tubes, convection losses from a cavity receiver, numerical solutions of turbulent models for flow over a flat plate with angle of attack, and the heat transfer from smooth horizontal tubes immersed in gas fluidized beds. A description is provided of aspects of turbulent combustion modelling, the exhaust gas emission from a swirl stabilized combustor, the analytical solution for diffusion in the core of a droplet with internal circulation, and the radiant ignition of a thin combustible solid. G.R.

A82-11743 * # **Solar power satellite microwave power transmission and reception system.** W. Finnell (NASA, Marshall Space Flight Center, Huntsville, AL). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 266-271. 10 refs.

The microwave power transmission and reception system of the Satellite Power System (SPS) has been intensively reviewed and assessed in a three-year concept development and evaluation program. This paper will review some concepts of SPS with particular emphasis on the design of the microwave power transmission and reception system. Technology requirements and proposals for meeting them will be discussed for various parts of the microwave system and to some degree for critical components such as power amplifiers. Specific subjects to be discussed are SPS concepts, antenna design, phase control, rectenna, and technology. (Author)

A82-11744 * # **Antenna optimization and cost consideration for the Solar Power Satellite microwave system.** E. M. Kerwin, J. H. Suddath, and G. D. Arndt (NASA, Johnson Space Center, Houston, TX). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 272-277. 10 refs.

The sizing, criteria, cost analysis, and optimized taper of the Solar Power Satellite (SPS) transmitting antenna are discussed. The sizing parameters considered were a thermal limit of 23 kW/sq m in the antenna, a peak power density of 23 mW/sq cm in the ionosphere, and cost effectiveness. Cost schedules and equations are presented for the SPS, and four antenna tapers are analyzed and compared, including the reference 10 dB Gaussian taper. An even powered quadratic series is formulated to minimize electricity cost and stay within thermal and ionospheric power level limits. The optimized Johnson Space Center taper is found to display the lowest energy costs, 4% below the 10 dB Gaussian, and can deliver 5.69 GW at 45.4 mills/kWh to the grid. Further studies are indicated for the optimal antenna and rectenna sizes. M.S.K.

A82-11746 # **Applications of power beaming from space-based nuclear power stations.** J. R. Powell, T. E. Botts (Brookhaven National Laboratory, Upton, NY), and A. Hertzberg (Washington, University, Seattle, WA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 288-295. 10 refs. Research supported by the U.S. Department of Energy.

Power beaming from space-based nuclear reactors to earth, aircraft, or spacecraft is offered as an alternative to the SPSS. A rotating bed reactor (RBR) is described, in which the nuclear fuel is an annular bed of small particulates held in a rotating basket through which a coolant passes. Advantages over a previous nuclear rocket program, NERVA, are given as minimized size, external moderation and reflection, and several GW available from a reactor about one cu m in size. Testing of a model fluidized bed is described, noting favorable results from U-233 fuel, a projected 50 cm diam bed, and total mass of 3 metric tons. Two Brayton cycle generator systems are examined, and it is found that a turbine inlet temperature of 2,000 K and a simple Brayton cycle without regeneration yields a best efficiency of 30%. The RBR components are discussed, and microwave and laser power beaming systems are compared; economic projections indicate laser beaming to cruising aircraft is competitive with current jet fuel use. M.S.K.

A82-12503 # **Microwave power transmission by satellites.** W. Keydel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Hochfrequenztechnik, Oberpfaffenhofen, West Germany). In: International Scientific Conference on Space, 21st, Rome, Italy, March 25, 26, 1981, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1981, p. 29-38. 16 refs.

The MPTS (microwave power transmission system) is examined with regard to the problems involved, the proposed solutions, the future outlook, and the necessity for further work. The MPTS is analyzed with regard to system considerations, design considerations (power transmission, frequency selection, power generation, the spacetenna, microwave propagation problems, the rectenna, and efficiency), environmental impacts (electromagnetic compatibility and RF interference, and health and ecological effects). It is concluded that the MPTS is feasible, but that further studies are needed to optimize the system with respect to such factors as efficiency and environmental impact. B.J.

A82-12504 # **Mechanical and nonlinear effects in microwave power transmission.** G. Franceschetti and I. Pinto (Napoli, Università, Naples, Italy). In: International Scientific Conference on Space, 21st, Rome, Italy, March 25, 26, 1981, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1981, p. 39-41. 11 refs.

The radiation recoil force arising in the spacetenna-rectenna link of a microwave power transmission system is discussed. Consideration is also given to power-wasting nonlinear phenomena (harmonic generation) that could be excited by the microwave beam passing through the ionosphere. Nonlinear effects that may occur in the spacetenna and rectenna are also examined. B.J.

A82-16991 **Space chamber experiments of ohmic heating by high power microwave from the Solar Power Satellite.** N. Kaya (Kobe University, Kobe, Japan) and H. Matsumoto (Kyoto University, Uji, Japan). *Geophysical Research Letters*, vol. 8, Dec. 1981, p. 1289-1292. 9 refs.

The prediction is made that a high power microwave from the Solar Power Satellite (SPS) interacts nonlinearly with the ionospheric plasma. The possible nonlinear interactions comprise ohmic heating and self-focusing and parametric instabilities. A laboratory experiment in a space plasma simulation chamber is carried out in order to examine ohmic heating in detail. A significant microwave heating plasma up to 150% temperature increase is observed with little electron density decrease. It is shown that the temperature increase is not due to the RF breakdown but to the ohmic heating in the simulated ionospheric plasma. C.R.

A82-17127 **The significance of hydrogen as future secondary energy carrier (Die Bedeutung von Wasserstoff als zukünftiger Sekundärenergieträger).** J. Nitsch (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *DFVLR-Nachrichten*, Nov. 1981, p. 2-6. In German.

An analysis is conducted concerning the possibilities for satisfying future energy requirements. Different types of energy requirements are considered together with the various classes of fuels which are currently employed to satisfy these requirements, taking into account developments that are changing present relationships. An investigation is conducted of alternate possibilities for supplying needed secondary gaseous energy carriers. According to one of the considered possibilities, hydrogen is to be provided by processes based on a large-scale utilization of solar energy. The structure of a hydrogen economy is discussed and questions regarding the economics of a use of hydrogen are explored. It is concluded that an employment of hydrogen as energy carrier depends also with respect to economic considerations primarily on the cost of electric energy. A description of the advantages of a hydrogen economy is also provided. G.R.

A82-17978 **International Microwave Symposium, Los Angeles, CA, June 15-19, 1981, Proceedings.** Symposium sponsored by the Institute of Electrical and Electronics Engineers and International Union of Radio Science. Edited by R. L. Eisenhart (Hughes Aircraft Co., Culver City, CA). *IEEE Transactions on Microwave Theory and Techniques*, vol. MTT-29, Dec. 1981. 144 p.

Papers presented in this volume cover diverse areas related to microwaves, including semiconductor devices, medical applications, circuit design, propagation, field theory, power, surface acoustic waves, ferrites, and measurements. Papers are included on the hybrid mode analysis of microstrip lines on anisotropic substrates, horn image-guide leaky-wave antenna, status of the microwave power transmission components for the solar power satellites, and analysis of microstrip circuits coupled to dielectric resonators. V.L.

A82-17982 * **Status of the microwave power transmission components for the solar power satellite.** W. C. Brown (Raytheon Co., Microwave and Power Tube Div., Waltham, MA). *(Institute of Electrical and Electronics Engineers and International Union of Radio Science, International Microwave Symposium, Los Angeles, CA, June 15-19, 1981.) IEEE Transactions on Microwave Theory and Techniques*, vol. MTT-29, Dec. 1981, p. 1319-1327. 14 refs. Research supported by the U.S. Department of Energy and NASA.

During the 1970-1980 time period a substantial advance has been made in developing all portions of a microwave power transmission system for the solar power satellite (SPS). The most recent advances pertain to the transmitting portion of the system in the satellite and are based upon experimental observations of the use of the magnetron combined with a passive directional device to convert it into a highly efficient directional amplifier with excellent low-noise properties and potentially very long life. The ability of its microwave output to track a phase reference makes it possible to combine it with many other radiating units to provide a highly coherent microwave beam. The ability of its output to track an amplitude reference while operating from a dc power source with varying voltage makes it possible to eliminate most of the power conditioning equipment that would otherwise be necessary. (Author)

N82-11256# Pittsburg Energy Technology Center, Pa. Combustion Technology Div.
TRANSPORT CHARACTERISTICS OF ALTERNATE SLURRY FUELS Quarterly Technical Progress Report, Apr. - Jun. 1981
1981 5 p Sponsored by DOE
(DE81-028580; DOE/TIC-10286S0) Avail: NTIS HC A02/MF A01

Progress is reported in an effort to develop flow data for various alternate fuels, such as coal/water mixtures, in a pump loop which accurately simulates fuel feed systems found in boiler and furnace applications. Instruments and procedures were selected for the measurement and correlation of pressure loss as a function of slurry characteristics and system design. An existing loop was redesigned by lengthening both the vertical and horizontal straight sections and by simplifying the tank discharge/pump suction inlet section to eliminate unnecessary bends or elbows. Locations were selected for the pressure measurements, temperature measurements, flow measurements, and grab sample ports. A data acquisition system was defined. DOE

N82-12520# Skelly and Loy, Harrisburg, Pa.
EVALUATION OF NOVEL UNDERGROUND TRANSPORT SYSTEMS Final Report
Jun. 1981 134 p refs
(Contract DE-AC01-79ET-11268)
(DE81-030279; DOE/ET-11268/T3) Avail: NTIS HC A07/MF A01

The feasibility of new or novel underground haulage equipment for transporting personnel and supplies is assessed to determine their relative impact on productivity and the cost per ton that is attributable to this segment of the mining operation. Novel equipment in its current design can potentially alleviate many of the personnel and supply problems encountered in United States coal mines. A review of rail haulage systems and European underground mining provided the basis for the introduction of three novel haulage systems: monorail, floor-mounted trapped rail haulage, and chairlifts. It was determined that monorail and floor-mounted trapped rail haulage systems exhibit the highest potential for domestic utilization. Monorail haulage equipment along with conventional battery powered rubber-tired equipment and two rail haulage systems were theoretically applied to five different mine sizes. Each system was then reviewed on an economic, operational, maintenance, and safety basis. From each standpoint, the monorail compared favorably with the other haulage systems. DOE

N82-12525# Battelle Columbus Labs., Ohio.
EXTENSIBLE BRIDGE-CONVEYOR CONCEPTS FOR COAL-MINE FACE HAULAGE Final Technical Report
James C. Swain, David L. Thomas, and Edward C. Mullen 1981 87 p
(Contracts DE-AC01-79ET-14210; DI-DM-JO-177051)
(DE81-031974; DOE/ET-14210/T1) Avail: NTIS HC A05/MF A01

The objective was to develop design concepts for extensible bridge conveyors which can be used in multiples to form a continuous haulage system. Consultation services were provided by Jeffrey Mining Machinery Division on mining technology and B.F. Goodrich Engineered Systems Division on conveyor belt technology. Additional information was gathered in a mine visit, during visits to conveyor manufacturers, and contacts with several component suppliers. Three extensible conveyor approaches were selected and machinery arrangement and internal detail drawings were prepared for each. Two of the concepts are for a face haulage system in which separate nonconnected extensible conveyors are individually trammed into position to form a continuous haulage system. The third concept is for a connected extensible system similar to existing continuous face haulage systems but employing extensible rather than fixed-length bridges. Cost estimates were prepared for the three concepts. The concepts developed employ belt-type conveyors, however, chain-type conveyors were considered to be a viable alternative. DOE

N82-12538*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
WORKSHOP ON MICROWAVE POWER TRANSMISSION AND RECEPTION. WORKSHOP PAPER SUMMARIES
1980 1366 p refs Workshop held in Houston, Tex., 15-18 Jan. 1980 Document contains eight bound supplements
(NASA-TM-84064) Avail: NTIS HC A99/MF A01 CSCL 10A

Microwave systems performance and phase control are discussed. Component design and reliability are highlighted. The power amplifiers, radiating elements, rectennas, and solid state configurations are described. The proper sizing of microwave transmission systems is also discussed.

N82-12539*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SYSTEM PERFORMANCE CONCLUSIONS
G. D. Arndt *In its* Workshop on Microwave Power Transmission and Reception 1980 p 1-12

Avail: NTIS HC A99/MF A01 CSCL 10A

System sizing is discussed in terms of reduced power levels and antenna diameters smaller than 1 km. The microwave transmission efficiency for smaller SPS systems was investigated. Startup and shutdown operations were examined with emphasis on solar eclipse effects on the solar arrays. The antennas and subarray mechanical alignments are also discussed. T.M.

N82-12641*# Axiomatix, Los Angeles, Calif.
AN ACTIVE ALIGNMENT SCHEME FOR THE MPTS ARRAY
Richard Iwasaki *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 26-31
Avail: NTIS HC A99/MF A01 CSCL 10A

In order to maximize the efficiency of the microwave power transmission system (MPTS), the surface of the array antenna must be extremely flat, which is difficult to achieve using passive techniques over the 1 km dimensions of the array. In order to achieve and maintain this required flatness, a rotating laser beam used for leveling applications on Earth was utilized as a reference system. A photoconductive sensor with a reflective collecting surface was used to determine the displacement and polarity of any misalignment and automatically engage a stepping motor to drive a variable-length mechanism to make the necessary corrections. Once aligned, little power is dissipated since a nulling bridge circuit that centers on the beam is used, an important alignment feature since even laser beams broaden considerably at 1 km distances. T.M.

N82-12642*# Los Alamos Scientific Lab., N. Mex.
IONOSPHERIC POWER BEAM STUDIES
Lewis M. Duncan and William E. Gordon (Rice Univ.) *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 32-43

Avail: NTIS HC A99/MF A01 CSCL 10A

A power density level of 23 mW/sq cm is presented as a design specification based on theoretical calculations of a threshold for microwave ionosphere nonlinear interaction (thermal runaway). For comparable power densities, enhanced electron heating is observed to change the electron temperature by a factor of two or three, but not by an order of magnitude. T.M.

N82-12643*# Emmanuel Coll., Boston, Mass.
PROPOSED EXPERIMENTAL STUDIES FOR ASSESSING IONOSPHERIC PERTURBATIONS ON SPS UPLINK PILOT BEAM SIGNAL
Santimay Basu and Sunanda Basu *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 44-54 refs

(Contract F19628-78-C-0005; Grant NSF ATM-78-25264)
Avail: NTIS HC A99/MF A01 CSCL 10A

The microwave beam of the proposed Solar Power Satellite (SPS) at geosynchronous altitude is to be formed and directed by phase information derived from a pilot signal at 2.45 GHz transmitted from ground and received in a number of module locations on the SPS antenna. The frequency of the pilot signal was chosen to be sufficiently low as to avoid the effects of strong scattering by turbulence in the neutral atmosphere and yet high enough to avoid any possible reofractive effects caused by the ionized upper atmosphere. The propagation of the uplink pilot signal through the ionosphere which contains natural and possibly some artificial irregularities, was studied. T.M.

N82-12646*# LinCom Corp., Pasadena, Calif.
COHERENT MULTIPLE TONE TECHNIQUE FOR GROUND BASED SPS PHASE CONTROL
C. M. Chie *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 85-94 refs
(Contract NAS9-15782)
Avail: NTIS HC A99/MF A01 CSCL 10A

The ground based phase control concept was studied as an alternative approach to the reference SPS phase control system. The details of the ground based phase control system study are documented. The coherent multiple tone technique used for the ground based phase measurement waveform design and phase control system is summarized. T.M.

N82-12647*# Novar Electronics Corp., Barberton, Ohio.
AN INTERFEROMETER-BASED PHASE CONTROL SYSTEM
James H. Ott and James S. Rice *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 95-98 refs

Avail: NTIS HC A99/MF A01 CSCL 10A

A system for focusing and pointing the SPS power beam is discussed. The system is ground based and closed loop. One receiving antenna is required on Earth. A conventional uplink data channel transmits an 8-bit phase error correlation back to the SPS for sequential calibration of each power module. Beam pointing resolution is better than 140 meters at the Rectenna. T.M.

N82-12648*# Novar Electronics Corp., Barberton, Ohio.
A SONIC SATELLITE POWER SYSTEM MICROWAVE POWER TRANSMISSION SIMULATOR
James H. Ott and James S. Rice *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 97-99 ref

Avail: NTIS HC A99/MF A01 CSCL 10C

A simulator which generates and transmits a beam of audible sound energy mathematically similar to the SPS power beam is described. The simulator provides a laboratory means for analysis of ground based closed loop SPS phase control and of ionospheric effects on the SPS microwave power beam. T.M.

N82-12649*# Boeing Aerospace Co., Seattle, Wash.
SPS PHASE CONTROL STUDIES
W. W. Lund, B. R. Sperber, and G. R. Woodcock *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 100-109
Avail: NTIS HC A99/MF A01 CSCL 10A

To properly point and form the SPS microwave power beam, the outputs of the power amplifiers in the transmitting array must be phased in a specific and coherent fashion. The purpose of the SPS phase control system is to bring this about reliably. A number of different phase control schemes were studied. The one selected for the SPS baseline system is a retrodirective CW phase that is distributed via fiber optics. The basis of this selection is relative technical simplicity and requisite assurance of success. T.M.

N82-12650*# Boeing Aerospace Co., Seattle, Wash.
SPS FIBER OPTIC LINK ASSESSMENT
T. O. Lindsay and Ervin J. Nalos *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 110-114

Avail: NTIS HC A99/MF A01 CSCL 10A

Fiber optic technology was selected in the SPS baseline design to transmit a stable phase reference throughout the microwave array. Over a hundred thousand microwave modules are electronically steered by the phase reference signal to form the power beam at the ground receiving station. The initially selected IF distribution frequency of the phase reference signal was set at 980 MHz or a submultiple of it. Fiber optics offers some significant advantages in view of the SPS application. Optical transmission is highly immune to EMI/RFI, which is expected to be severe when considering the low distribution power. In addition, there will be savings in both mass, physical size, and potentially in cost. T.M.

N82-12651*# Rockwell International Corp., Pittsburgh, Pa.
IONOSPHERIC EFFECTS IN ACTIVE RETRODIRECTIVE ARRAY AND MITIGATING SYSTEM DESIGN
A. K. Nandi and C. Y. Tomita *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 115-125 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

The operation of an active retrodirective array (ARA) in an ionospheric environment (that is either stationary or slowly-varying) was examined. The restrictions imposed on the pilot-signal structure as a result of such operation are analyzed. A 3-tone pilot beam system is defined which first estimates the total electron content along paths of interest and then utilizes this information to aid the phase conjugator so that correct beam pointing can be achieved. T.M.

N82-12553*# Boeing Aerospace Co., Seattle, Wash.
HIGH EFFICIENCY SPS KLYSTRON DESIGN
Ervin J. Nalos *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 127-136

Avail: NTIS HC A99/MF A01 CSCL 10A

The most likely compact configuration to realize both high efficiency and high gain is a 5-6 cavity design focused by an electromagnet. An outline of a potential klystron configuration is given. The selected power output of 70 kW CW resulted from a maximum assumed operating voltage of 40 kV. The basic klystron efficiency cannot be expected to exceed 70-75% without collector depression. Although impressive gains were achieved in raising the basic efficiency from 50% to 70% or so with a multi-stage collector, the estimated efficiency improvement due to 5-stage collector at the 75% level is only about 8% resulting in an overall efficiency of about 83%. T.M.

N82-12553*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTIC INVESTIGATION OF EFFICIENCY AND PERFORMANCE LIMITS IN KLYSTRON AMPLIFIERS USING MULTIDIMENSIONAL COMPUTER PROGRAMS; MULTISTAGE DEPRESSED COLLECTORS; AND THERMIONIC CATHODE LIFE STUDIES
H. G. Kosmahl *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 139-148 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

Due to complexity of the program which used a hydrodynamic, axially and radially deformable disk-ring model and the resulting long computing time only the output gap was investigated. Results from independent studies were used to initiate the starting conditions for the electrons and the RF voltage using our program. Although this method of computation is less exact than processing the entire klystron interaction in 3-Dimensions it is shown that, for a confined flow focused throughout the penultimate cavity, radial velocities remain very small and the beam is highly laminar. It is concluded that possible errors resulting from treating only the output cavity in 3-D would remain small. T.M.

N82-12554*# Raytheon Co., Waltham, Mass. New Products Center.
THE ADAPTING OF THE CROSSED-FIELD DIRECTIONAL AMPLIFIER TO THE REQUIREMENTS OF THE SPS Progress Report
William C. Brown *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 147-155 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

Progress in adapting the crossed-field directional amplifier to the SPS is reviewed. Special emphasis is given to (1) recent developments in controlling the phase and amplitude of the microwave power output, (2) a received architecture for its placement in the subarray, and (3) recent developments in the critical pivotal areas of noise, potential cathode life, and efficiency. Author

N82-12555*# Boeing Aerospace Co., Seattle, Wash.
SPS ANTENNA ELEMENT EVALUATION
C. D. Lunden, W. W. Lund, and Ervin J. Nalos *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 158-165

Avail: NTIS HC A99/MF A01 CSCL 10A

The SPS transmitting array requires an architecture which will provide a low weight, high efficiency and high structural rigidity. Waveguide slot arrays constitute the most desirable option. Consequently, such an array was chosen for the SPS. Waveguide slot arrays offer high efficiency, uniform illumination, and are fairly lightweight. Bandwidths of such arrays are narrow, typically 1/2-2%. Although this does not directly impact the SPS, which transmits power at a single frequency of 2.45 GHz, the narrow bandwidth does constrain the thermal and mechanical tolerances of the antenna. The purpose of this program is to better define the electronic aspects of an SPS specific waveguide slot array. The specific aims of the program are as follows: (1) To build a full-scale half-module, 10 stick, array, the design parameters for which are to be determined analytical considerations tempered by experimental data on a single slotted radiating stick, (2) To experimentally evaluate the completed array with respect to antenna pattern, impedance and return loss; and (3) To measure swept transmission amplitude and phase to provide a data base for design of a receiving antenna. L.F.M.

N82-12556*# Rockwell International Corp., Pittsburgh, Pa.
THE RESONANT CAVITY RADIATOR (RCR)
K. G. Schroeder, R. L. Carlise, and C. Y. Tomita *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 167-177

Avail: NTIS HC A99/MF A01 CSCL 10A

The fundamental theory of MW antenna operation and basic array technology development status was used in the design of the 1-km diameter 5-Gw SPS microwave antenna. However, the aperture size and the high efficiency requirements make the MW antenna extremely complex. Studies show that the slotted waveguide array is one of the most efficient radiators for the antenna. Subsequent analyses show that the temperature interface between waveguides and dc-RF conversion tubes can cause severe thermal design problems on the array. An alternate design, the Resonant Cavity Radiator, is described here. L.F.M.

N82-12557*# Boeing Aerospace Co., Seattle, Wash.
EVALUATION OF THICK WALL WAVE GUIDE ELEMENT
Ervin J. Nalos *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 180-187
Avail: NTIS HC A99/MF A01 CSCL 10A

The SPS transmitting array requires an archetecture which will provide a low weight, high efficiency and high structural rigidity. As noted above, waveguide slot arrays constitute the most desirable option. Consequently, such an array has been chosen for the SPS. Waveguide slot arrays offer high efficiency, uniform illumination, are are fairly lighweight. Bandwidths of such arrays are narrow, typically 1/2-2%. Although this does not directly impact the SPS, which transmits power at a single frequency of 2.45 GHz, the narrow bandwidth does constrain the thermal and mechanical tolerances of the antenna. The purpose of this program is to better define the electronic aspects of an SPS specific waveguide slot array. The specific aims of the program are as follows: (1) To build a full-scale half-module, 10 stick, array, the design parameters for which are to be determined by analytical considerations tempered by experimental data on a single slotted radiating stick, (2) To experimentally evaluate the completed array with respect to antenna pattern, impedance and return loss, and (3) To measure swept transmission amplitude and phase to provide a data base for design of a receiving antenna. L.F.M.

N82-12558*# Raytheon Co., Waltham, Mass. New Products Center.
METHOD FOR PRECISION FORMING OF LOW-COST, THIN-WALLED SLOTTED WAVEGUIDE ARRAYS FOR THE SPS
William C. Brown *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 188-190
Avail: NTIS HC A99/MF A01 CSCL 10A

A method for the precision-forming of thin-walled, slotted-waveguide arrays was devised. Models were constructed with temporary tools and evaluated. The application of the method to the SPS requirements is discussed. Author

N82-12559*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
CONSIDERATIONS FOR HIGH ACCURACY RADIATION EFFICIENCY MEASUREMENTS FOR THE SOLAR POWER SATELLITE (SPS) SUBARRAYS
D. J. Kozakoff, J. M. Schuchardt, and C. E. Ryan *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 191-200 refs

(Contract NAS9-33605)
Avail: NTIS HC A99/MF A01 CSCL 10A

The relatively large apertures to be used in SPS, small half-power beamwidths, and the desire to accurately quantify antenna performance dictate the requirement for specialized measurements techniques. Objectives include the following: (1) For 10-meter square subarray panels, quantify considerations for measuring power in the transmit beam and radiation efficiency to + or - 1 percent (+ or - 0.04 dB) accuracy. (2) Evaluate measurement performance potential of far-field elevated and ground reflection ranges and near-field techniques.

(3) identify the state-of-the-art of critical components and/or unique facilities required. (4) Perform relative cost, complexity and performance tradeoffs for techniques capable of achieving accuracy objectives. the precision required by the techniques discussed below are not obtained by current methods which are capable of + or - 10 percent (+ or - dB) performance. In virtually every area associated with these planned measurements, advances in state-of-the-art are required. L.F.M.

N82-12560*# Raytheon Co., Waltham, Mass. New Products Center.
THE HISTORY OF THE DEVELOPMENT OF THE RECTENNA
William C. Brown *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 203-212 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

The history of the development of the rectenna is first reviewed through its early conceptual and developmental phases in which the Air Force and Raytheon Company were primarily involved. The intermediate period of development which involved NASA, Jet Propulsion Laboratory, and Raytheon is then reviewed. Some selective aspects of the current SPS rectenna development are examined. Author

N82-12561*# Boeing Aerospace Co., Seattle, Wash.
RECTENNA SYSTEM DESIGN
G. R. Woodcock and R. W. Andryczyk (GE) *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 213-222

Avail: NTIS HC A99/MF A01 CSCL 10A

Various rectenna system options are discussed. Among these are the half-wave dipole, modified half-wave dipole, yagi, half-wave dipole stripline, air dielectric transmission line feed, full wavelength dipole stripline, parabolic horn, and parabolic trough. L.F.M.

N82-12562*# Rensselaer Polytechnic Inst., Troy, N. Y.
RECTENNA SESSION: MICRO ASPECTS
Ronald J. Gutmann *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 223-231 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

Two micro aspects of rectenna design are discussed: evaluation of the degradation in net rectenna RF to DC conversion efficiency due to power density variations across the rectenna (power combining analysis) and design of Yagi-Uda receiving elements to reduce rectenna cost by decreasing the number of conversion circuits (directional receiving elements). The first of these involves resolvinga fundamental question of efficiency potential with a rectenna, while the second involves a design modification with a large potential cost saving. L.F.M.

N82-12563*# Novar Electronics Corp., Barberton, Ohio.
A THEORETICAL STUDY OF MICROWAVE BEAM ABSORPTION BY A RECTENNA
James H. Ott, James S. Rice, and Donald C. Thorn *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1981 p 234-240 refs

Avail: NTIS HC A99/MF A01 CSCL 10A

The results of a theoretical study of microwave beam absorption by a Rectenna are given. Total absorption of the power beam is shown to be theoretically possible. Several improvements in the Rectenna design are indicated as a result of analytic modeling. The nature of Rectenna scattering and atmospheric effects are discussed. Author

N82-12564*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RECTENNA ARRAY MEASUREMENT RESULTS
Richard M. Dickinson *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 244-250 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

The measured performance characteristics of a rectenna array are reviewed and compared to the performance of a single element. It is shown that the performance may be extrapolated from the individual element to that of the collection of elements. Techniques for current and voltage combining were demonstrated. The array performance as a function of various operating parameters is characterized and techniques for overvoltage protection and automatic fault clearing in the array demonstrated. A method for detecting failed elements also exists. Instrumentation for deriving performance effectiveness is described. Measured harmonic radiation patterns and fundamental frequency scattered patterns for a low level illumination rectenna array are presented. Author

N82-12565*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SESSION ON SOLID STATE: INTRODUCTION
In its Workshop on Microwave Power Transmission and Reception 1980 p 253-257
Avail: NTIS HC A99/MF A01 CSCL 10A

The possibilities of using solid state devices as part of the Satellite Solar Power System are discussed. Solid state advantages and disadvantages are presented along with two potential concepts for use of solid state in the system design. L.F.M.

N82-12566*# Boeing Aerospace Co., Seattle, Wash.
MODIFIED REFERENCE SPS WITH SOLID STATE TRANSMITTING ANTENNA
G. R. Woodcock and B. R. Sperber *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 268-267

Avail: NTIS HC A99/MF A01 CSCL 10A

The motivations for considering solid state microwave power amplifiers for the solar power satellite transmitting antenna are the possibilities of greatly increased system reliability due to elimination of electron tube cathodes, a lower mass per unit power and transmitting array area due to the high power densities obtainable in semiconductors, and, probably, cost savings due to development of small hardware items that can be handled by individuals instead of organizations. In order to provide a fair assessment where we stand today with regard to solid state SPS technology, the design described here is close to that of the NASA/DOE reference and is implemented using today's solid state technology with only a small 'push'. The small push is raising the efficiency of DC-RF conversion from the .68 obtained by RCA in 1975 to somewhat over .8 of the solid state SPS. This is generally considered feasible by semiconductor industry representatives. Other solid state SPS configurations can yield somewhat better performance. However, these generally do not provide as fair a vehicle for comparison with the reference and usually also incorporate somewhat more advanced technologies. L.F.M.

N82-12567*# Boeing Aerospace Co., Seattle, Wash.
SPS SOLID STATE ANTENNA POWER COMBINER
G. W. Fitzsimmons *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 268-277
Avail: NTIS HC A99/MF A01 CSCL 10A

Solid state dc-rf converters offer potential improvements in reliability, mass and low voltage operation, provided that anticipated efficiencies in excess of 80 percent can be realized. Field effect transistors offer the greatest potential in the SPS frequency band at 2.45 GHz. To implement this approach it is essential that means be found to sum the power of many relatively low power solid state sources in a low-loss manner, and that means be provided to properly control the phase of the outputs of the large number of solid state sources required. To avoid the power combining losses associated with circuit hybrids it was proposed that the power from multiple solid state amplifiers be combined by direct coupling of each amplifier's output to the radiating antenna structure. The selected power-combining antenna consists of a unique printed (metalized) microstrip circuit on a ceramic type dielectric substrate which is backed by a shallow lightweight aluminum cavity which sums the power of four microwave sources. The antenna behaves like two one-half wavelength slot-line antennas coupled together via their common cavity structure. L.F.M.

N82-12568*# Rockwell International Corp., Pittsburgh, Pa.
SOLID-STATE RETRODIRECTIVE PHASED ARRAY CONCEPTS FOR MICROWAVE POWER TRANSMISSION FROM SOLAR POWER SATELLITE
K. G. Schroeder and I. K. Petroff *In* NASA. Johnson Space Center Workshop on Microwave Power Transmission and Reception 1980 p 279-298 ref
Avail: NTIS HC A99/MF A01 CSCL 10A

Two prototype solid-state phased array systems concepts for potential use in the Solar Power Satellite are described. In both concepts, the beam is centered on the rectenna by means of phase conjugation of a pilot signal emanating from the ground. Also discussed is on-going solid-state amplifier development. L.F.M.

N82-13167# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
EFFECTS OF THE SATELLITE POWER SYSTEM ON LOW EARTH ORBIT AND GEOSYNCHRONOUS SATELLITES
W. B. Grant, E. L. Morrison, and J. R. Juroshek. Jun. 1981 86 p refs
(Contracts DE-AI06-79RL-10077; DE-AI01-80ER-10160)
(PB81-232019; NTIA/Rept-81/75) Avail: NTIS HC A05/MF A01 CSCL 22A

The large amount of power contained in the main beam and principal sidelobes of the proposed Solar Power System (SPS), now under study by DOE and NASA, potentially presents an EMC problem for other satellite systems. This report examines selected geosynchronous orbit (GEO) satellites in adjacent slots to an SPS, GEO satellites on a chord passing an Earth horizon, and low-earth-orbit (LEO) satellites which may pass throught the SPS power beam. Potential functional and operational impacts to on-board systems are analyzed. Mitigation techniques for SPS effects are examined, and recommendations summarized to allow satellites to operate satisfactorily in an SPS environment. GRA

N82-13517# Brookhaven National Lab., Upton, N. Y.
CRYOGENIC TESTING OF 100-M SUPERCONDUCTING POWER TRANSMISSION TEST FACILITY
R. J. Gibbs, J. E. Jensen, and R. A. Thomas. 1981 8 p refs Presented at 1981 Cryogenic Engr. Conf., San Diego, 10 Aug. 1981
(Contract DE-AC02-76CH-00016)
(DE81-028331; BNL-29900; CONF-810835-2) Avail: NTIS HC A02/MF A01

The system was designed to cool the test facility for transmission cables. The system was modified to incorporate a fourth turbine placed remotely from the refrigerator at the far end of the load. In this configuration the load, consisting of the superconducting cables and their containment vessel, becomes a long counterflow heat exchanger with internal heat generation. The results of these tests are presented with discussion of the operation, equipment performance, and possible areas for improvement. T.M.

N82-14202*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARATIVE ANALYSES OF SPACE-TO-SPACE CENTRAL POWER STATIONS
Paul F. Holloway and L. Bernard Garrett. Dec. 1981 49 p refs
(NASA-TP-1955; L-14766) Avail: NTIS HC A03/MF A01 CSCL 22B

The technological and economical impact of a large central power station in Earth orbit on the performance and cost of future spacecraft and their orbital transfer systems are examined. It is shown that beaming power to remote users cannot be cost effective if the central power station uses the same power generation system that is readily available for provision of onboard power and microwave transmission and reception of power through space for use in space is not cost competitive with onboard power or propulsion systems. Laser and receivers are required to make central power stations feasible. Remote power transmission for propulsion of orbital transfer vehicles promises major cost benefits. Direct nuclear pumped or solar pumped laser power station concepts are attractive with laser thermal and laser electric propulsion systems. These power stations are also competitive, on a mass and cost basis, with a photovoltaic power station. E.A.K.

N82-14484# Los Alamos Scientific Lab., N. Mex.
COOL-DOWN FLOW-RATE LIMITS IMPOSED BY THERMAL STRESSES IN LNG PIPELINES
J. K. Novak, F. J. Edeskuty, and J. R. Bartlit. 1981 8 p refs Presented at the Cryogenic Eng. Conf., San Diego, Calif., 10-14 Aug. 1981
(Contract W-7405-eng-36)
(DE81-028731; LA-UR-81-2365; CONF-810835-4) Avail: NTIS HC A02/MF A01

Warm cryogenic pipelines are usually cooled to operating temperature by a small, steady flow of the liquid cryogen. If this flow rate is too high or too low, undesirable stresses will be produced. Low flow-rate limits based on avoidance of stratified two-phase flow were calculated for pipelines cooled with liquid hydrogen or nitrogen. High flow-rate limits for stainless steel and aluminum pipelines cooled by liquid hydrogen or nitrogen were determined by calculating thermal stress in thick components vs flow rate and then selecting some reasonable stress limits. The present work extends these calculations to pipelines made of AISI 304 stainless steel, 6061 aluminum, or ASTM A420 9% nickel steel cooled by liquid methane or a typical natural gas. Results indicate that aluminum and 9% nickel steel components can tolerate very high cool-down flow rates, based on not exceeding the material yield strength. DOE

N82-14638# Texas Technological Univ., Lubbock. Plasma and Switching Lab.
PULSED POWER RESEARCH COLLOQUIUM Annual Report
M. Kristiansen, A. H. Guenther (Kirtland AFB, Albuquerque, N.M.), John Ungvarsky (AFWL, Kirtland AFB, Albuquerque, N.M.), F. C. Brockhurst (Air Force Inst. of Technology, Wright-Patterson, AFB, Ohio), R. D. Franklin (AFWAL), A. K. Hyder (AFOSR), and R. L. Gullickson (Defense Nuclear Agency). 9 Jul. 1981 10 p refs
(Grant AF-AFOSR-3675-78; AF Proj. 2301)
(AD-A105770; AFOSR-81-0686TR) Avail: NTIS HC A02/MF A01 CSCL 10/2

A Pulsed Power Lecture Series is being conducted by Texas Tech University for the U.S. Air Force. Modular instructional material for use in this lecture series is being developed. Each module is a self consistent discussion of some aspect of pulsed power technology. The contents range from the very basic (e.g. basic EM field theory) to advanced, modern topics, such as magnetic switching. The lectures are delivered every two weeks at the Air Force Institute of Technology and the Air Force Weapons Laboratory. The speakers then provide a written text of their lecture, which is edited and published in modular form by Texas Tech University. It is planned to reissue these modules in report or book form at a later date. A total of about 50 modules are planned. Some 30 lecturers have been presented, to date, and about 12 modules have been issued. Author (GRA)

N82-15134# Technische Hochschule, Aachen (West Germany). Inst. fuer Kunststoffverarbeitung in Industrie und Handwerk.
SELECTION AND TESTING OF SUITABLE COATING SYSTEMS FOR STEEL PIPES USED FOR LONG DISTANCE HEAT TRANSFER Final Report, May 1980
Ernst Broches. Bonn: Bundesministerium fuer Forschung und Technologie, Aug. 1981 85 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-138; ISSN-0340-7608) Avail: NTIS HC A05/MF A01

Anticorrosion properties of buried, plastics-coated steel pipes for long-distance heat supply lines, with regard to the possible application limits are considered. Quantitative measuring methods were used to determine the influence of various media, temperatures, and temperature changes on the protective effect of the composites systems. Electrochemical measuring methods (impedance and potential measurement), bond strength measurements and optical tests were employed. It was possible to achieve a very good differentiation between the level of protection offered by the individual coating systems and show how they were affected by the various kinds of stress applied. The electrochemical measuring methods, in particular, were outstandingly suitable for a quasi-nondestructive evaluation of a composite system subjected to various stresses. It was also possible to show that the PU coating system did not lose any of its protective properties in any of the tests. J.M.S.

N82-15336# Brookhaven National Lab., Upton, N. Y.
IMPROVED TECHNIQUE TO MEASURE ELECTRONICALLY AC LOSSES IN SUPERCONDUCTING CABLES
F. Schauer and M. Meth. 1981 8 p refs Presented at the Cryogenic Eng. Conf., San Diego, Calif., 10-14 Aug. 1981
(Contract DE-AC02-76CH-00016)
(DE81-029323; BNL-29932; CONF-810835-15) Avail: NTIS HC A02/MF A01

An improved electronic method for measuring ac losses in superconducting cables of lengths from 1m to 10m was developed. This method compensates for phase shifts in the measuring circuit elements and for imbalance of the difference amplifier due to changes in the common mode voltage. This measuring method is being further improved and adapted to the loss measurements of a 138V, 4 kA, 100 m long superconducting cable under construction. DOE

07
ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

A82-10018 **Thermal storage in salt-hydrates.** M. Telkes (AEC Research Institute, Killeen, TX). In: Solar materials science. New York, Academic Press, 1980, p. 377-404. 68 refs.

Water itself has a rather high entropy of fusion per unit weight, and when combined with anhydrous salt of high entropy of fusion, a salt hydrate of conveniently lower melting point may result, usually with the combined high entropies of fusion of the components. Aspects of melting and recrystallization are discussed. Several methods have been developed to prevent the settling of residual solids in partly incongruently melting salt-hydrates, with the result that the conditions can become completely reversible. The properties of salt-hydrates are listed in a table. Attention is given to supercooling, nucleation or crystal seeding, the rate of crystal growth, the rate of heat removal, the calculation of the heat of fusion from heats of solution, the calculation of the heat of fusion from entropies of fusion, calorimetric measurements and data, and the properties of selected salt-hydrates. G.R.

A82-10019 **Thermodynamic basis for selecting heat storage materials.** M. Telkes (AEC Research Institute, Killeen, TX). In: Solar materials science. New York, Academic Press, 1980, p. 405-437. 25 refs.

The search for materials with high heat of fusion values can be based on theoretical considerations regarding the heat of fusion and its correlation with other known physical properties. Attention is given to investigations conducted by Kubaschewski (1949, 1959, 1967), Blanc (1952, 1959), and Ubbelohde (1950, 1957, 1965). It is found that Kubaschewski's rule can be applied to calculate the heat of fusion of inorganic compounds, by using definite values for the entropy of fusion per gram atom. It is pointed out that most of the theoretical work of the past has been hampered by lack of data on the heats of fusion of elements. Using recently published results a nearly complete table has been prepared, listing melting points, transition points, heats of fusion and transition, and entropies of fusion and transition. G.R.

A82-11707 * # **Development status of a regenerative fuel cell system for orbital operation.** A. C. Erickson (General Electric Co., Wilmington, MA) and H. McBryar (NASA, Johnson Space Center, Houston, TX). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 67-73. 6 refs. Contract No. NAS9-15831.

Mission studies conducted by NASA for future long-term orbital operations have indicated the need for substantial increases in the power level of low-earth orbital energy storage facilities by the mid-to-late 1980's. A description is presented of the results of a comprehensive study for a state-of-the-art assessment of solid polymer electrolyte electrochemical cell technology. Questions related to the weight optimization of the dedicated system are investigated, and attention is given to the analysis of a system having reversible modules capable of operating in either the electrolysis or fuel cell mode. It was found that performance improvements and weight reduction can be realized by advancing the state of the art of solid polymer electrolyte cell technology. G.R.

A82-11714 # **Effect of depth of discharge on cycle life of near-term batteries.** H. N. Seiger. In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 102-110. 35 refs. Research sponsored by the U.S. Department of Energy.

An investigation is conducted regarding the functional relationship between cycle life and depth of discharge (DOD) for lead-acid, nickel-iron, and nickel-zinc batteries. Also considered are the main factors affecting the degree to which cycle life is affected by DOD. The failure modes which affect the cycle life of the three systems are listed in a table. A semilogarithmic relationship between cycle life and DOD will be maintained for several years. Maximum energy is found to be related to battery voltage, DOD, and cycle life. G.R.

A82-11722 # **Techniques and applications of pulsed power technology.** M. F. Rose (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 146-154. 18 refs. Navy-supported research.

For the purpose of pulse power, energy is usually stored, at a slow rate, in some suitable media and subsequently released on demand at whatever rate is suitable. The time scales for delivery range from milliseconds to nanoseconds. The most demanding technical applications for this technology are in inertial confinement fusion and in military oriented programs. A description of the basic storage mechanisms is provided, taking into account the electrostatic storage of energy, magnetic/inductive storage, inertial energy storage, and chemical storage. A comparison of large storage systems is conducted, and aspects of load characterization are discussed. Attention is given to advanced applications and advanced requirements. G.R.

A82-11735 # **The nickel-hydrogen battery system - An historical overview.** L. Miller (Eagle-Picher Industries, Joplin, MO). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 220-223.

Around 1971, difficulties experienced in connection with the development of a regenerative or rechargeable hydrogen oxygen fuel cell for replacement of the nickel-cadmium system on Intelsat communication satellites resulted in the consideration of two related, alternative systems, including the oxygen-cadmium couple and the hydrogen-nickel couple. The oxygen-cadmium couple was soon eliminated for technical reasons. On the other hand, immediate achievement of success with the hydrogen-nickel couple resulted in its subsequent rapid development. A chronological review is provided of the major events leading up to the current system status of the nickel-hydrogen battery. G.R.

A82-11737 # **Ampere-hour integrator battery charge controller.** G. M. Lehto and R. M. Martinelli (Hughes Aircraft Co., Space and Communications Group, El Segundo, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 232-234.

In a spacecraft environment proper battery management is essential to ensure long battery life. A primary cause of reduced battery life is the improper rate and duration of battery charge. The Ampere-hour Integrator Battery Charge Controller presents a method of autonomous charge management which offers significant advances in the control of charge return to the battery. (Author)

A82-11774 * # **NASA preprototype redox storage system for a photovoltaic stand-alone application.** N. H. Hagedorn (NASA, Lewis Research Center, Cleveland, OH). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 805-811.

A 1-kW preprototype redox storage system that has undergone characterization tests and been operated as the storage device for a 5-kW (peak) photovoltaic array is described and performance data are presented. Loss mechanisms are discussed, and simple design changes leading to appreciable increases in efficiency are suggested. The effects on system performance of nonequilibrium between the predominant species of complexed chromic ion in the negative electrode reactant solution are summarized. It is noted that with the aid of the prototype system, control concepts have been shown to be

valid and trouble free and some insight has been gained into interactions at the mutual interfaces of the redox system, the photovoltaic array, the load, and the control devices. C.R.

A82-11779 # Method of determining the creep characteristics of composite materials. S. J. Calabrese and P. Smith (Rensselaer Polytechnic Institute, Troy, NY). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 871-874. 5 refs. Research supported by the U.S. Department of Energy.

This paper presents the test method used to establish the creep characteristics of composite materials which were selected for use in a flywheel energy storage system under contract to the Department of Energy. The test specimen, rig and environmental chamber were designed to obtain data under air and vacuum conditions. A capacitance measuring system was used to monitor displacement over a long period of time. Results of preliminary testing and a discussion of future work will be presented. (Author)

A82-11782 # Design considerations for a 1500 M head 300-600 MW double stage reversible pump/turbine with regulation. S. A. Chacour, J. R. Degnan, and R. K. Fisher, Jr. In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 1014-1020. 6 refs.

It is noted that much attention has recently been given to the development of high-head pumped storage schemes. The special design considerations required to develop the turbine machinery for this new category of service are presented. Also included is a discussion of the advanced computer-aided design and analytical tools now available to optimize the prototype equipment. Special manufacturing considerations and model testing philosophy are introduced. It is noted that an optimized final machine design results from computer-aided mechanical design, detailed structural analysis, and a prediction of fatigue life. C.R.

A82-11846 # Aquifer thermal energy storage - A feasibility study for large scale demonstration. W. V. Skinner and D. J. Supkow (Dames and Moore, Cranford, NJ). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2161-2166.

Engineering procedures necessary for aquifer thermal energy storage (ATES), based on studies of the Magothy Aquifer on Long Island, NY, are presented, with chilled winter water pumped into the aquifer and reclaimed in summer months for air conditioning. The choice of aquifer involves necessary volume, flow rate, efficiency of thermal recovery, and avoidance of conflict with other users; utilization depends on choice of appropriate piping, heat exchangers, and well construction to prevent degradation of the aquifer. The methods employed to probe the Magothy for suitability are described, including drilling an asymmetric well cluster for observation, and 48 hr pumping and 8 hr recovery. Transmissivity was found to vary from 8,000 to 29,000 sq ft/day. A doublet well was then drilled and water withdrawn, chilled, and returned. Later withdrawal indicated a 46% thermal recovery, with computer models projecting 80% with additional cycling. The study verified the feasibility of ATES, which can be expanded with additional demand. M.S.K.

A82-11847 # Planning an underground pumped hydro project for the Commonwealth Edison Company. H. H. Chen (Harza Engineering Co., Chicago, IL) and I. A. Berman (Commonwealth Edison Co., Chicago, IL). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 3. New York, American Society of Mechanical Engineers, 1981, p. 2167-2171.

The conceptual project design for a one-drop 3 GW underground pumped hydro energy storage in Illinois is presented. A one-drop two stage design was chosen over a one-drop one stage and one and two stage two-drop designs for reasons of cost and flexibility. Water is to be pumped into a bisected upper reservoir set in preCambrian granite, which is sufficiently impermeable to water; the 10.4 million cu m reservoir can then be used as a load leveler as it drains through a pump/turbine into a 2.5 million cu m lower reservoir. Initial studies indicate that pumped hydro storage exceeds the efficiencies of both oil and peaking plant generation. Due to a decrease in the projected rate of increase of electrical demand, the project has been deferred, allowing time for work on ultrahigh-head pump turbines. M.S.K.

A82-13082 * Control of new energy sources in an electric utility system. H. Kirkham (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Joint Automatic Control Conference, Charlottesville, VA, June 17-19, 1981, Proceedings. Volume 1. New York, American Institute of Chemical Engineers, 1981. 4 p. (WA-3B). Research sponsored by the U.S. Department of Energy and NASA.

The addition of generators based on renewable resources to the electric power system brings new problems of control and communication if the generators are to be controlled as an integrated part of the power system. Since many of these generators are small, it will require a large number of them, connected to the distribution system, to represent an appreciable fraction of the total generation. This situation contrasts with present day generation control which typically involves only the control of a small number of large generators. This paper examines the system requirements for integrated control, and proposes a control arrangement in which the incremental cost of power is an important parameter. (Author)

A82-13326 The new batteries. J. Hopkinson. *EPRI Journal*, vol. 6, Oct. 1981, p. 7-13.

The state of advanced battery concept development is reviewed, noting advantages of battery use such as modular design, short lead time from order to installation, and widely varying load operation. Compact design, quietness, pollution free operation, and low maintenance are also favorable; utility uses are foreseen as load leveling for base load capacity, the opportunity for a spinning reserve, and VAR control. Research programs for ZnCl, ZnBr, and the beta battery are reviewed, and the use of Pb-acid batteries is noted to be reaching an end because of lead supply problems, pollution, and price fluctuations. A 50 kWh ZnCl battery has been built that has lasted through 2 cycles, and a 80kW ZnBr battery has recently tested successfully to prove the feasibility of scale-up. Functioning chemicals in the beta battery require over 300 C temperatures to work; beta aluminum, a ceramic, is used as an electrolyte and separator. Seals to contain the reactive chemicals within the battery and compartmentalize the electrolytes are a focus of continuing research. M.S.K.

A82-14513 † Optimum reinforcement shapes and paths for rotating composite shells (Optimal'nye formy i traektorii armirovaniia vrashchaiushchikhsia obolochek iz kompozitov). Iu. V. Bokov, V. V. Vasil'ev, and G. G. Portnov (Moskovskii Aviatsionnyi Tekhnologicheskii Institut, Moscow, USSR; Akademiia Nauk Latviiskoi SSR, Institut Mekhaniki Polimerov, Riga, Latvian SSR). *Mekhanika Kompozitnykh Materialov*, Sept.-Oct. 1981, p. 846-854. 11 refs. In Russian.

The paper deals with the problem of an optimum design for a composite flywheel in the form of a zero-moment shell of revolution fabricated by filament winding or by layup of orthotropic bands. The reinforcement paths and the shape of the generating line are derived for a uniformly stressed centrifugally loaded shell. A closed-form solution is obtained for the case of a composite lacking rigidity in the direction normal to the direction of reinforcement. On the basis of the proposed solution, several classes of optimum shells are derived. The energy storage capacity of such shells is estimated and compared with that of rim-type flywheels. V.L.

A82-15726 Rechargeable lithium/vanadium oxide cells utilizing 2Me-THF/LiAsF6. K. M. Abraham, J. L. Goldman, and M. D. Dempsey (EIC Laboratories, Inc., Newton, MA). *Electrochemical Society, Journal*, vol. 128, Dec. 1981, p. 2493-2501. 21 refs. Grant No. DAAK20-79-C-0267.

Various vanadium oxide compositions were synthesized and evaluated as rechargeable lithium/vanadium oxide cell cathodes using 2Me-THF/LiAsF6. The most useful compositions were found to be: (1) VO(2.17), (2) VO(2.16), and (3) the Fe- or Cr-substituted oxide of apparent composition M(0.13)V(0.87)O(2.17). The superior rechargeability of VO(2.17) in practical high-capacity cells within

cycling limits of 3.0 and 1.9 V was demonstrated by the extended cycling of a cell with an average cathode utilization of about 0.52 electrons/vanadium in over 200 cycles. Both VO(2.17) and VO(2.19) oxides require carbon in the cathode for acceptable performance, resulting in merely moderate volumetric energy densities. The incorporation of such metals as Cr or Fe into the vanadium oxide lattice is found to be useful in the synthesis of new cathode materials. O.C.

A82-15727 **Insoluble sulfide positive electrodes for organic electrolyte lithium secondary batteries.** F. W. Dampier (EIC Corp., Newton, MA). *Electrochemical Society, Journal*, vol. 128, Dec. 1981, p. 2501-2506. 29 refs. Contract No. EY-76-C-02-2520.

A82-17763 # **A photovoltaic system with energy storage Natural Bridges National Monument 100-kW system.** F. J. Solman, H. J. Bullwinkel, J. D. Doucet, and B. L. Brench (MIT, Lexington, MA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0068*. 9 p. 13 refs. Research sponsored by the U.S. Department of Energy.

A large, stand-alone photovoltaic power system with energy storage has been in operation for over 18 months at Natural Bridges National Monument in southeastern Utah. Operating results for the system are in substantial agreement with simulations done before construction. Measured data are now available for the battery performance over this period. The design considerations and how they were realized are reviewed as are the departures from predicted performance. The performance of a digital state-of-charge meter used for battery management is also discussed. (Author)

A82-17770 # **Performance of a cylindrical phase change thermal energy storage unit.** R. Ponnappan and D. L. Jacobson (Arizona State University, Tempe, AZ). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0076*. 9 p. 13 refs. Contract No. F33615-77-C-2069.

The high-temperature performance of a eutectic salt Phase Change Material (PCM) in a cylindrical Thermal Energy Storage Container (TESC) sample is evaluated by means of an experimental apparatus with a water-circulated calorimeter. The phase change characteristics of the salt during melting and solidification were observed by monitoring the external axial temperature profile of the container, and the analysis of the phase change heat transfer in the cylindrical geometry was based on the modified heat balance integral method of Tien (1980), which provides the solidification rate and time. Melting point (983 K), freezing point (944 K), latent heat of fusion (782.26 J/gm) and thermal diffusivity (0.00799 sq cm/sec) results are in agreement with those found in the literature. The experimental and analytical results of the nondimensionalized heat transfer resistance as a function of the solidified or melted weight fraction are compared. O.C.

A82-18488 **Life-testing of 1.7 kW h zinc-chloride battery system - Cycles 1 - 1000.** C. M. Blevins (Energy Development Associates, Madison Heights, MI). *Journal of Power Sources*, vol. 7, Jan. 1982, p. 121-132. 5 refs. Research supported by the Electric Power Research Institute and Gulf and Western Industries.

A 1.7 kW h zinc-chloride battery system was built in 1976 for electric vehicle and load-leveling applications. As of June 1979, the two-volt, multiple-cell battery stack, which embodies porous graphite-chlorine electrodes, accumulated 1000 charge-discharge cycles. The operation of the 1.7 kW h system depends upon a network of peripheral components that comprise four subsystems: (1) the electrolyte loop; (2) the chlorine gas loop; (3) the hydrogen recombination loop; and (4) the hydrate storage and decomposition loop. The system has attained 40% of the cycle life target for a commercial load-leveling battery. Over one-half year of operation or 138 cycles without electrolyte maintenance have been achieved to date. Internal inspection of the cell and examination of electrode voltage data indicate that the chlorine electrodes have remained stable and that the goal of 2500 cycles will be reached. J.F.

N82-10503*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF POSITIVE PULSE CHARGE WAVEFORMS ON THE ENERGY EFFICIENCY OF LEAD-ACID TRACTION CELLS Final Report
John J. Smithrick Sep. 1981 11 p refs
(Contract DE-AI01-77CS-51044)
(NASA-TM-82709; E-991; DOE/NASA/51044-22) Avail: NTIS HC A02/MF A01 CSCL 10A

The effects of four different charge methods on the energy conversion efficiency of 300 ampere hour lead acid traction cells were investigated. Three of the methods were positive pulse charge waveforms; the fourth, a constant current method, was used as a baseline of comparison. The positive pulse charge waveforms were: 120 Hz full wave rectified sinusoidal; 120 Hz silicon controlled rectified; and 1 kHz square wave. The constant current charger was set at the time average pulse current of each pulse waveform, which was 150 amps. The energy efficiency does not include charger losses. The lead acid traction cells were charged to 70 percent of rated ampere hour capacity in each case. The results of charging the cells using the three different pulse charge waveforms indicate there was no significant difference in energy conversion efficiency when compared to constant current charging at the time average pulse current value. Author

N82-10508# California Univ., Livermore. Lawrence Livermore Lab.
MECHANICAL ENERGY STORAGE TECHNOLOGY PROJECT Annual Report, 1980
T. M. Barlow, W. T. Crothers, T. T. Chiao, D. N. Frank, D. M. King, and S. V. Kulkarni 1 May 1981 203 p refs
(Contract W-7405-eng-48)
(DE81-029753; UCRL-50058-80) Avail: NTIS HC A10/MF A01

Progress during 1980 in the development and evaluation of the energy-saving potential of flywheel energy storage systems for vehicles and for fixed-base power systems is reported. Activities related to transportation applications, fixed-base applications, fiber-composite materials technology, flywheel rotor and containment technology, advanced component technology, and project management are described. DOE

N82-10525# Hibbing Public Utilities Commission, Minn.
FEASIBILITY OF A SMALL SCALE PUMPED STORAGE DEMONSTRATION PROJECT, HIBBING, MINNESOTA
1981 229 p refs Prepared in cooperation with Hansen (James) and Associates, Springfield, Vt.
(Contract DE-AC07-76ID-01570)
(DE81-028678; DOE/TIC-1028678; IDO-10097) Avail: NTIS HC A11/MF A01

The economic and technical feasibility of developing a 5 to 15 MW pumped storage power plant was examined. The substitution of power from a pumped storage facility for the purchased peak power is advantageous because: (1) the coal fired cogeneration plant operates with an improved heat rate; (2) numerous open pits from abandoned iron ore mines are available as reservoirs for pumped storage; and (3) the peaking power generated does not depend on petroleum fuel. It is suggested that: eight mine sites are suitable for pumped storage; oil fired peak power units should be avoided to improve the efficiency of the existing cogeneration; this is a nonpolluting form of power generation; and the development of small scale reversible pump/turbine units for commercial operation is desirable. DOE

N82-10527# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 1: EXECUTIVE SUMMARY Final Report
May 1981 111 p Sponsored in part by Electric Power Research Inst. Prepared for Potomac Electric Power Company, Washington, D.C.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(DE81-029440; EPRI-EM-1589-Vol-1; DOE/ET-5047/1) Avail: NTIS HC A06/MF A01

A preliminary design study of water compensated Compressed Air Energy Storage (CAES) and Underground Pumped Hydroelectric (UPH) plants for siting in geological conditions suitable for hard rock excavations was performed. The study was divided

into five primary tasks as follows: establishment of design criteria and analysis of impact on power system; selection of site and establishment of site characteristics; formulation of design approaches; assessment of environmental and safety aspects; and preparation of preliminary design of plant. The salient aspects considered and the conclusions reached during the consideration of the five primary tasks for both CAES and UPH are presented. DOE

N82-10628# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 2: PROJECT DESIGN CRITERIA: UPH Final Report
May 1981 185 p refs Sponsored in part by Electric Power Research Inst. Prepared for Potomac Electric Power Co., Washington, D.C.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(DE81-028107; EPRI-EM-1589-Vol-2; DOE/ET-5047/2) Avail: NTIS HC A09/MF A01

The design criteria for an underground pumped hydroelectric (UPH) storage facility having a maximum generating capacity of 2000 MW and a storage capacity of 20,000 MWh at a nominal head of 5000 ft are documented. The UPH facility is a two step configuration with single stage reversible pump turbines, each step consisting of a 1000 MW plant at a nominal head of 2500 ft. Overall design criteria including operating requirements, civil/structural criteria, geotechnical criteria, mechanical criteria and electrical criteria are detailed. Specific requirements are given for the upper reservoir, intake/outlet structure, penstock and draft tubes, powerhouses, transformer galleries, intermediate reservoir, lower reservoir, shafts and hoists, switchyard and surface buildings. The requirements for the power plant electrical and mechanical equipment, including pump turbine and motor generator units, are referred to. Electrical design criteria are given to meet the requirements of two power houses located underground at different depths, but these criteria may not necessarily reflect PEPCO's current engineering practice. The criteria refer to a specific site and take into account the site investigation results. The design criteria given were used as the basis for the plant design. DOE

N82-10629# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 5: SITE SELECTION Final Report
Apr. 1981 148 p refs Sponsored in part by Electric Power Research Inst. Prepared for Potomac Electric Power Co., Washington, D.C.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(DE81-028199; EPRI-EM-1589-Vol-5; DOE/ET-5047/5) Avail: NTIS HC A07/MF A01

A six-step site selection process undertaken to identify and subsequently rank potential sites suitable for either an underground pumped hydroelectric (UPH) facility, or a water-compensated hard-rock cavern compressed air energy storage (CAES) facility is described. The region of study was confined to the service area of the Potomac Electric Power Company (PEPCO) and contiguous areas. Overriding considerations related to geology, environmental impact and transmission-line routing were studies within the context of minimizing plant costs. The selection process led to the identification of several sites suitable for the development of either a CAES or an UPH facility. Design development and site exploration at the selected site are described. DOE

N82-10630# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 9: DESIGN APPROACHES, CAES. APPENDIX D: MECHANICAL SYSTEMS Final Report
Apr. 1981 104 p Sponsored in part by Electric Power Research Inst. Prepared for Potomac Electric Power Company, Washington, D.C.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(DE81-028200; EPRI-EM-1589-Vol-9-App-D; DOE/ET-5047/9D) Avail: NTIS HC A06/MF A01

The development of the design approach taken for the mechanical systems included in a compressed air energy storage (CAES) facility were documented. Design approaches developed the fuel oil system, water supply system, waste treatment system, fire protection and safety system, and miscellaneous plant services are based on similar designs for conventional utility plants because the operating characteristics, design parameters, and equipment capabilities for CAES plant mechanical systems are similar to standard utility systems. The design approach for each of these systems develops several alternatives for achieving the CAES plant requirements in each area. The preferred alternative is then expanded into a preliminary system description. DOE

N82-10632# GeoTrans, Inc., Herndon, Va.
REVIEW OF SIMULATION TECHNIQUES FOR AQUIFER THERMAL ENERGY STORAGE (ATES)
James W. Mercer, Charles R. Faust, William J. Miller, and F. J. Pearson, Jr. Mar. 1981 225 p refs Prepared in cooperation with INTERA, Environmental Consultants, Inc., Houston, Texas Prepared for Pacific Northwest Lab., Richland, Washington
(Contract DE-AC06-76RL-01830)
(DE81-029943; PNL-3769) Avail: NTIS HC A10/MF A01

The analysis of aquifer thermal energy storage (ATES) systems rely on the results from mathematical and geochemical models. Therefore, the state-of-the-art models relevant to ATES were reviewed and evaluated. These models describe important processes active in ATES including ground-water flow, heat transport (heat flow), solute transport (movement of contaminants), and geochemical reactions. In general, available models of the saturated ground-water environment are adequate to address most concerns associated with ATES; that is, design, operation, and environmental assessment. In those cases where models are not adequate, development should be preceded by efforts to identify significant physical phenomena and relate model parameters to measurable quantities. DOE

N82-10636# Brobeck (William M.) and Associates, Berkeley, Calif.
DYNAMIC STABILITY OF STACKED DISK TYPE FLYWHEELS
F. C. Younger Apr. 1981 47 p refs Prepared for California Univ., Lawrence Livermore Lab.
(Contract W-7405-eng-48)
(DE81-030008; UCRL-15372) Avail: NTIS HC A03/MF A01

A flywheel assembly formed from adhesively bonded stacked fiber composite disks was analyzed. The stiffness and rigidity of the assembly required to prevent unconrolled growth in the deformations due to centrifugal force was determined. It is shown that stacked disk type flywheels become unstable when the speed exceeds a critical value. This critical value of speed depends upon the stiffness of the bonded attachments between the disks. It is found that elastomeric bonds do not provide adequate stiffness to insure dynamic stability for high speed stacked disk type flywheels. DOE

N82-10640# Mitre Corp., McLean, Va. Metrek Div.
STATUS OF THE DOE BATTERY AND ELECTROCHEMICAL TECHNOLOGY PROGRAM 2
R. Roberts Dec. 1980 278 p refs Presented at Dept. of Energy Battery and Electrochem. Contractor's Conf., 10-12 Dec. 1979
(Contract DE-AC01-79ET-25407)
(DE81-029879; DOE/ET-25407/1) Avail: NTIS HC A13/MF A01

The status of electrochemical storage systems is reviewed. Secondary batteries were recommended. However, selected mechanically rechargeable batteries and aspects of energy conservation in industrial electrochemistry were included. Batteries included are: lead acid, nickel/iron, nickel/zinc; advanced: lithium/metal sulfide, sodium/sulfur, zinc/chlorine; and research and development: metal/air, hydrogen/chlorine, zinc/bromine, redox, organic electrolytes, solid state. Electrode reactions, cell performance modeling, new battery materials are examined. Energy conservation and alternative processes in electrochemical industry are reviewed. The potential contributions of the battery program to the various missions supported such as electric vehicles, photovoltaic systems, distributed electrical energy systems, and energy conservation in industry are discussed. DOE

N82-10646# Potomac Electric Power Co., Washington, D.C.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 3: PROJECT DESIGN

CRITERIA: CAES Final Report
Apr. 1981 218 p Prepared in cooperation with Acres American, Inc., Columbia, Md.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(DE81-028197; EPRI-EM-1589-Vol-3) Avail: NTIS HC A10/MF A01

The design criteria presented provided the basis for development of the design approaches and preliminary plant design. These design criteria are based, where possible, upon related facilities and experiences and are representative of normal utility practices. They cover the major plant equipment, systems, and facilities and the plant characteristics which depend upon or have an impact on plant surroundings. Project team studies and outside development contracts concentrated on those areas where current technology or practice does not provide adequate information to support plant design activities or economic analyses. DOE

N82-10548# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
RAPID CHARGING OF LEAD-ACID BATTERIES FOR ELECTRIC-VEHICLE PROPULSION AND SOLAR-ELECTRIC STORAGE
P. Longrigg Jun. 1981 44 p refs
(Contracts EG-77-C-01-4042; DE-AC02-77CH-00178)
(DE81-028084; SERI/RR-742-1068) Avail: NTIS HC A03/MF A01

A survey of the various charging techniques that are available and that have been used extensively for lead acid batteries is presented. Descriptions of newer techniques involving gas evolution controlled charging are also included. An evaluation of fast charge approaches, with an analysis of battery state equations, is presented. DOE

N82-10549# Oak Ridge Y-12 Plant, Tenn. Fabrications Systems Dept.
COMPOSITE FLYWHEEL BALANCE EXPERIENCE
R. S. Steele 6 Apr. 1981 9 p refs Presented at the IECEC Conf., Atlanta, 9-14 Aug. 1981
(Contract W-7405-eng-26)
(DE81-769341; Y/DX-290; CONF-810812-2) Avail: NTIS HC A02/MF A01

The high performance composite flywheels which have properties useful in reducing the total energy requirements for automobiles were examined. This requires high rotational speeds and solution to the accompanying problems of fatigue and vibration control through balancing of the rotor. Demonstrated that composite flywheels, require significant balancing and expenses to meet the minimum balance requirements practiced in industry. Flywheels experience balance changes with speed changes. DOE

N82-10556# Argonne National Lab., Ill.
NEAR-TERM BATTERIES FOR ELECTRIC VEHICLES
C. C. Christianson, N. P. Yao, and F. Hornstra 1981 9 p refs Presented at the 8th Energy Technol. Conf. and Expo, Washington, D.C., 9-11 Mar. 1981
(Contract W-31-109-eng-38)
(DE81-023543; CONF-810315-13) Avail: NTIS HC A02/MF A01

Major progress achieved in the lead-acid, nickel/iron and nickel/zinc battery technology development since the initiation of the Near-Term eV Battery Project in 1978 is reported. Against the specific energy goal of 56 wh/kg the demonstrated specific energies are 41 wh/kg for the improved lead-acid batteries, 48 wh/kg for the improved nickel/iron batteries, and 68 wh/kg for the improved nickel/zinc batteries. These specific energy values would allow an ETV-1 vehicle to have an urban range of 80 miles in the case of the improved lead-acid batteries, 96 miles for the improved nickel/zinc batteries, and 138 miles for the improved lead-acid batteries. All represent a significant improvement over the state-of-the-art lead-acid battery capability of about 30 wh/kg with approximately a 51 mile urban range for the ETV-1 vehicle. DOE

N82-10557# Argonne National Lab., Ill. Chemical Engineering Div.
RECENT PROGRESS IN LITHIUM/IRON SULFIDE BATTERY DEVELOPMENT
D. L. Barney, R. K. Steunenberg, and A. A. Chilenskas 1980 28 p refs Presented at the 15th Intersoc. Energy Conversion Eng. Conf., Seattle, 18-22 Aug. 1980
(Contract W-31-109-eng-38)
(DE81-023127; CONF-800806-46) Avail: NTIS HC A03/MF A01

The development of high temperature lithium/iron sulfide batteries for electric vehicle propulsion and stationary energy storage is described. In the Mark 2 program, various improvements are made in the cells and battery hardware to eliminate the potential failure mechanisms. In the cell development effort, multiplate cells with three positive and four negative electrodes were fabricated. A charger equilizer concept is developed, in which the major portion of the charge is added to the battery as a whole and then the individual cells are charged to a predetermined cutoff voltage. DOE

N82-10574# Acres American, Inc., Columbia, Md.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 12: PLANT DESIGN, CAES Final Report
Apr. 1981 285 p Sponsored in part by Electric Power Research Inst. Prepared for Potomac Electric Power Company, Washington, D.C.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(DE81-028110; EPRI-EM-1589-Vol-12; DOE/ET-5047/12) Avail: NTIS HC A13/MF A01

Detailed designs were developed for the major components and systems of the CAES plant. These designs were based upon the preliminary economic and technical evaluations and alternative designs developed in Task 3C. The detailed project design drawings for the major plant systems and structures are presented. The site development report, updated cost estimate, cost/schedule risk study, reliability/availability, analysis, and recommendations for additional research and development are included. DOE

N82-10962# Argonne National Lab., Ill.
STATUS OF NICKEL/ZINC AND NICKEL/IRON BATTERY TECHNOLOGY FOR ELECTRIC VEHICLE APPLICATIONS
N. P. Yao, C. C. Christianson, R. C. Elliott, and J. F. Miller 1980 43 p refs Presented at the 29th Power Sources Conf., Cherry Hill, N.J., 10-13 Jun. 1980
(Contract W-31-109-eng-38)
(DE81-023572; CONF-800612-8) Avail: NTIS HC A03/MF A01

Progress in nickel/zinc and nickel/iron technology was to achieve battery technical performance goals necessary for widespread use in electric vehicle applications is reviewed. Nickel/zinc module test data show a specific energy of nearly 70 Whr/kg and a specific power of 130 W/kg. Nickel/iron moduls demonstrate a specific energy of nearly 50 Wh/kg and a specific power of 100 W/kg. Energy efficiency is improved from less than 50 percent to over 65 percent. Cost reduction is emphasized in the development of both nickel/zinc and nickel/iron batteries to achieve the lowest possible life cycle cost to the battery user. DOE

N82-11388# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
INVESTIGATION OF THE ZINC ELECTRODE REACTION Annual Report, 1 Oct. 1979 - 30 Sep. 1980
James McBreen Dec. 1980 138 p refs
(Contract DE-AC02-76CH-00016)
(DE81-030221; BNL-51370) Avail: NTIS HC A07/MF A01

In nickel-zinc batteries, with pasted zinc electrodes, zinc electrode shape change or redistribution of the active material from the edge of the electrodes toward the center is the major life-limiting factor. In batteries with soluble free electrolyte zinc electrodes, morphology changes, particularly under random cycling conditions, is a major operational problem. Insights and possible solutions to these two problems are considered. The areas covered include: (1) additive and substrate effects on zinc electrode morphology; (2) investigations of zinc electrodes of the second kind; (3) separator effects on zinc electrode shape change; and (4) investigation of the effect of modified charging methods on the morphology and behavior of both pasted and soluble free electrolyte zinc electrodes. DOE

N82-11547*# Munising Paper Div., Neenah, Wis.
DEVELOPMENT OF BATTERY SEPARATOR COMPOSITES Final Report, Oct. 1976 - Nov. 1981
George F. Schmidt and Robert E. Weber Nov. 1981 56 p

refs
(Contract NAS3-20583)
(NASA-CR-165508) Avail: NTIS Hc A04/MF A01 CSCL 10C

Improved inorganic-organic separators developed by NASA were commercially prepared. A single-ply asbestos substrate was developed, as well as alternative substrates based on cellulose and on polypropylene fibers. The single-ply asbestos was bound with butyl rubber and was functionally superior to the formerly used polyphenylene oxide saturated sheet. Commercially prepared separators exhibited better measured separator properties than the NASA standard. Cycle life in Ni/Zn and Ag/Zn cells was related to substrate, decreasing in the order: asbestos > cellulose paper > nonwoven polypropylene. The cycle life of solvent-coated separators was better than aqueous in Ni/Zn cells, while aqueous coatings were better in Ag/Zn cells. T.M.

N82-11578# Argonne National Lab., Ill. Chemical Engineering Div.
CALCIUM/METAL SULFIDE BATTERY DEVELOPMENT PROGRAM. Progress Report, Oct. 1979 - Sep. 1980
D. L. Barney, M. F. Roche, S. K. Preto, L. E. Rose, N. C. Otto, and F. J. Martino Mar. 1981 24 p refs Prepared for California Univ., Lawrence Berkeley Lab.
(Contract W-31-109-eng-38)
(ANL-81-14) Avail: NTIS HC A02/MF A01

Components needed to fabricate a high performance calcium cell were identified. The components are: (1) Ca-Al-Si negative electrode; (2) Fe sub 0.93 Co sub 0.075 sub 2 positive electrode; (3) Bn felt separator; (4) iron negative and molybdenum positive current collectors; and (5) LiCl-NaCl-CaCl2-BaCl2 electrolyte. E.A.K.

N82-11580# Varta Batterie A.G., Kelkheim (West Germany).
RECENT ADVANCES IN LEAD-ACID CELL RESEARCH AND DEVELOPMENT
Ernst Voss 1980 38 p refs Presented at the EVA Conf., Adelia, Australia, 25-29 Aug. 1980 Sponsored in part by Bundesministerium fuer Forschung und Technologie Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE81-023104; CONF-8008118-1) Avail: NTIS HC A03/MF A01

During the last decade it was demonstate that the lead-acid system is capable of proving an attractive energy source of sufficient energy and power per unit weight and volume which allows its sucessful application for electric vehicle propulsion. This is shown by a number of typical examples, such as the relationship between active-material properties and capacity at high rates of discharge the effect of acid stratification and others. Simultaneously, the expenditure for the maintenance of lead-acid batteries was minimized by the development of peripheric equipment, as there are means for central-automatic water refill and recombination devices. It is shown that there is still a considerable potential for further improvement which might again strengthen the unique position of the lead-acid system in the market in comparison to competitive systems. T.M.

N82-11584# California Univ., Berkeley. Lawrence Berkeley Lab.
OVERVIEW OF THE APPLIED BATTERY AND ELECTROCHEMICAL RESEARCH PROGRAM
F. McLarnon Jun. 1981 15 p Presented at the 4th DOE Battery and Electrochem. Contractors' Conf., Washington, D.C., 2 Jun. 1981
(DE81-027397; LBL-12890; CONF-810642-5) Avail: NTIS HC A02/MF A01

This purpose of this program is to provide the applied research base which supports all of DOE's electrochemical systems missions, and the general objective is to help provide batteries and electrochemical systems that can satisfy economic, performance and schedule requirements. The specific goal is to identify the most promising electrochemical technologies and transfer them to industry and/or another DOE program for further development and scale-up. DOE

N82-11585# California Univ., Berkeley. Lawrence Berkeley Lab.
RECHARGEABLE MOLTEN-SALT CELLS
Elton J. Cairns Oct. 1980 23 p refs Presented at the 158th Meeting of the Electrochem. Soc., 3rd Intern. Symp. on Molten Salts, Phys. Electrochem. Div., Hollywood, Fla., 5-10 Oct. 1980
(Contract W-7405-eng-48)
(DE81-027091; LBL-11090; CONF-8010158-12) Avail: NTIS HC A02/MF A01

Rechargeable molten-salt cells offer the opportunity for achieving higher specific energy than is available from ambient temperature cells (200 W-h/kg), and a specific power in excess of 100 W/kg. Two main of rechargeable cells employing molten salts are statistical those with a molten salt as the sole electrolyte, and those with a combination of a solid electrolyte and a molten salt electroylte. The status, recent research, and current problems for each of several systems in the above two categories are discussed. DOE

N82-11586# California Univ., Livermore. Lawrence Livermore Lab
MECHANICAL ENERGY STORAGE TECHNOLOGY (MEST) DEVELOPMENT
Thomas M. Barlow 22 Jun. 1981 8 p refs Presented at the Mech., Magnetic, and Underground Energy Storage Ann. Contractors' Rev., Washington, D.C., 24-26 Aug. 1981
(Contract W-7405-eng-48)
(DE81-026800; UCRL-86297) Avail: NTIS HC A02/MF A01

The objectives, approaches, structure, and principal accomplishments of the flywheel technology program during FY 1981 are summarized. International flywheel-related technology and complementary efforts in the United States are reviewed. DOE

N82-11620# Potomac Electric Power Co., Washington, D.C.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES: UPH Final Report
Jun. 1981 297 p Prepared in cooperation with Acres American, Inc., Buffalo, N.Y. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(DE81-030673; EPRI-EM-1589-Vol-8) Avail: NTIS HC A11/MF A01

The development of the design approaches used to determine the plant and overall layout for a underground pumped hydroelectric (UPH) storage facility having a maximum generating capacity of 2000 MW and a storage capacity of 20,000 MWh is discussed. Key factors were the selection of the high head pump-turbine equipment and the geotechnical considerations relevant to the underground cavern designs. The comparison of pump-turbine alternatives is described leading to the selection for detailed study of both a single-step configurations, using multistage reversible pump-turbines, and a two-step configuration, with single-stage reversible pump-turbines. DOE

N82-11621# Potomac Electric Power Co., Washington, D.C.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 9: DESIGN APPROACHES: CAES, APPENDIX C. MAJOR MECHANICAL EQUIPMENT Final Report
Apr. 1981 108 p refs Prepared in cooperation with Acres American, Inc., Columbia, Md. Sponsored in part by Electric Power Research Inst.
(Contract DE-AC02-77ET-28013; EPRI Proj. 1081-1)
(DE81-030672; EPRI-EM-1589-Vol-9-App-C) Avail: NTIS HC A06/MF A01

The major mechanical equipment includes the turbine-motor/generator, compressor train, intercooler/aftercooler system, and exhaust gas recuperator. The design criteria for each of these components is interrelated with, and dependent upon, each of the other components within the major mechanical equipment group. Careful consideration of this dependency has resulted in an overall design approach which satisfies the requirements of the CAES operational cycle while providing for a conservative component design. DOE

N82-11987# Aerospace Corp., Los Angeles, Calif.
ASSESSMENT OF FLYWHEEL SYSTEM BENEFITS IN SELECTED VEHICLE APPLICATIONS
L. H. Kubo and L. Forrest 1981 7 p refs Presented at IECEC Conf., 9 Aug. 1981
(Contract DE-AC08-79ET-26306)

(DE81-028978; CONF-810812-31) Avail: NTIS HC A02/MF A01

The performance of vehicle systems incorporating energy storage flywheels was investigated. The effort involved an indepth assessment of flywheel system benefits in two vehicle applications: a four-passenger commuter car with electric drive (flywheel range extension application) and a six-passenger family car with conventional heat engine drive (flywheel fuel conservation application). The special case of the six-passenger vehicle as used in taxicab service was also investigated. A number of possible component design/selection alternatives for flywheel rotors, continuously variable transmissions, batteries, motors, and other propulsion elements were examined. Results of the assessment are provided for the case of a series-configuration heat engine/flywheel drive train as used in the passenger car and urban taxi vehicle missions. DOE

N82-12398# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.

STUDY OF ATES THERMAL BEHAVIOR USING A STEADY FLOW MODEL

Christine Doughty, Goeran Hellstroem, Chin Fu Tsang, and Johan Claesson (Lund Inst. of Tech.) Jan. 1981 79 p refs

(Contract W-7405-eng-48)

(DE81-030883; LBL-11029; PNL-3924) Avail: NTIS HC A05/MF A01

The thermal behavior of a single well aquifer thermal energy storage system in which buoyancy flow is neglected is studied. A dimensionless formulation of the energy transport equations for the aquifer system is presented, and the key dimensionless parameters are discussed. A simple numerical model is used to generate graphs showing the thermal behavior of the system as a function of these parameters. Some comparisons with field experiments are given to illustrate the use of the dimensionless groups and graphs. DOE

N82-12445*# Sales-McCoin Tractionmatic, Inc., El Paso, Tex.

DESIGN STUDY OF A CONTINUOUSLY VARIABLE ROLLER CONE TRACTION CVT FOR ELECTRIC VEHICLES Final Report

Dan K. McCoin and R. D. Walker Sep. 1980 197 p refs

(Contract DEN3-115; EC-77-A-31-1044)

(NASA-CR-159841; DOE/NASA/0115-80/1; Sales-McCoin-80-SMT-002) Avail: NTIS HC A09/MF A01 CSCL 13I

Continuously variable ratio transmissions (CVT) featuring cone and roller traction elements and computerized controls are studied. The CVT meets or exceeds all requirements set forth in the design criteria. Further, a scalability analysis indicates the basic concept is applicable to lower and higher power units, with upward scaling for increased power being more readily accomplished. S.L.

N82-12574*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF ADVANCED CHROMIUM ELECTRODES FOR THE NASA REDOX ENERGY STORAGE SYSTEM Final Report

Randall F. Gahn, JoAnn Charleston, Jerri S. Ling, and Margaret A. Reid Nov. 1981 23 p refs

(Contract DE-AI04-80AL-12726)

(NASA-TM-82724; E-1025; DOE/NASA/12726-15) Avail: NTIS HC A02/MF A01 CSCL 10C

Chromium electrodes were prepared for the NASA Redox Storage System with meet the performance requirements for solar-photovoltaic, wind-turbine and electric utility applications. Gold-lead catalyzed carbon felt electrodes up tp 930 sq cm were fabricated and tested in single cells and multicell stacks for hydrogen evolution, coulombic efficiency, catalyst stability and electrochemical activity. Factors which affect the overall performance of a particular electrode include the carbon felt lot, the cleaning treatment and the gold catalyzation method. Effects of the chromium solution chemistry and impurities on charge/discharge performance are also presented. Author

N82-12586# Battelle Pacific Northwest Labs., Richland, Wash.

BIBLIOGRAPHY OF THE SEASONAL THERMAL ENERGY STORAGE LIBRARY

L. S. Prater, G. Casper (Midwest Research Inst.), and R. A. Kewin (Control Data Corp.) Aug. 1981 310 p

(Contract DE-AC06-76RL-01830)

(DE81-030470; PNL-3845) Avail: NTIS HC A14/MF A01

Seasonal storage of thermal energy which contributes to the relief of the national energy storage is described. Various forms of surplus energy (winter chill, summer heat, and industrial waste heat) are stored till needed. Potential storage media include: aquifers, lakes, ponds, and earth. Storage of thermal energy in aquifers is chosen for initial development. Other methods of seasonal storage are also evaluated. DOE

N82-13377 Purdue Univ., Lafayette, Ind.

APPLICATION OF A GRAVITY-DRIVEN WICKLESS HEAT PIPE FOR ICE PRODUCTION IN A COLD ENERGY STORAGE SYSTEM Ph.D. Thesis

Shun-Lung Chao 1981 255 p

Avail: Univ. Microfilms Order No. 8123621

Use of seasonal cold storage for space cooling is considered. A simplified analytical model, simulated by a computer program, was developed to predict the system performance. Experiments were performed to study the effects of various parameters on the ice formation. Parameters studied include the quantity of working fluid, condenser length, coolant inlet temperature, cooling time, type of working fluid, and inclination of the heat pipe. The effects of these parameters on the volume and shape of the resulting ice formation and on the wall temperature distribution along the heat pipe are illustrated. Evaporation and condensation phenomena within the heat pipe were investigated. The influence of natural convection on the geometry and structure of the ice is also discussed. The analytical model was found to be adequate for predicting the rate of ice formation and the geometry associated with the ice-water interface, and was verified by comparisons with experimental observations. Dissert. Abstr.

N82-13544# Public Service Co. of Indiana, Plainfield.

COMPRESSED AIR ENERGY STORAGE: PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 2: UTILITY SYSTEM PLANNING Final Report

31 Jul. 1981 112 p refs Sponsored in part by EPRI

(Contracts DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI Proj. 1081-3)

(DE82-000466; DOE/ET-29232/T4-Vol-2) Avail: NTIS HC A06/MF A01

The performance of an aquifer compressed air energy storage system was studied. The benefits derived from the integration of a compressed air energy storage facility with a hypothetical electrical network are analyzed. Scenarios of 100 percent coal, 50 percent coal and 50 percent nuclear, and 100 percent nuclear base load capacity additions were examined. Favorable economics are indicated when compressed air energy storage is installed as an alternative to combustion turbine peaking capacity on a system with a significant amount of oil fired generation. DOE

N82-14852# Battelle Pacific Northwest Labs., Richland, Wash. Office of Seasonal Thermal Energy Storage Program.

WASTE HEAT AND CHILL STORAGE IN AQUIFER SYSTEMS

Jay R. Eliason 1981 10 p refs Presented at the 3rd Conf. on Waste Heat Management and Utilization, Miami, Fla., 12 May 1981

(Contract DE-AC06-76RL-01830)

(DE81-028016; PNL-SA-9164; CONF-810545-8) Avail: NTIS HC A02/MF A01

Seasonal storage of thermal energy in aquifers is discussed. Winter chill, summer heat, and various forms of industrial waste heat and chill can be stored for future demand, reducing the need for generating primary energy. This seasonal storage of heat and chill in aquifer systems is assessed. DOE

N82-14855# California Univ., Livermore. Lawrence Livermore Lab.

FLYWHEEL ROTOR AND CONTAINMENT TECHNOLOGY DEVELOPMENT

S. V. Kulkarni 11 Aug. 1981 14 p refs Presented at the Mech., Magnetic, and Underground Energy Storage 1981 Ann. Contractors' Rev. Meeting, Washington, D.C., 24-27 Aug. 1981

(Contract W-7405-eng-48)

(DE81-028047; UCRL-86557; CONF-810833-7) Avail: NTIS HC A02/MF A01

An economical and practical composite flywheel with an energy density of 88 Wh/kg at failure, an operational energy density of 44 to 55 Wh/kg, and an energy storage capacity of approximately 1 kWh was developed. The suitability of various manufacturing processes for low cost rotor fabrication is determined, flywheel and flywheel systems dynamics are investigated. Prototype rotors for use in transportation and stationary applications and a fail safe, lightweight, and low cost flywheel containment are evaluated. DOE

N82-16510# Battelle Pacific Northwest Labs., Richland, Wash.
RESERVOIR STABILITY STUDIES
T. J. Doherty Jul. 1981 9 p refs Presented at Mech. Magnetic and Energy 1981 Ann. Contractors Review Meeting, Washington, D.C., 24 Aug. 1981
(Contract DE-AC06-76RL-01830)
(DE81-030099; PNL-SA-9782; CONF-810833-9) Avail: NTIS HC A02/MF A01

Stability criteria for large underground reservoirs in salt domes, hard rock caverns, and porous rock structures for air storage in utility applications were studied. Reservoir stability commercialization of compressed air energy storage (CAES) systems was emphasized. A state-of-the-art assessment, numerical model development and experimental studies culminating in field research, was formulated. Site specific geotechnical design evaluations using methodologies to assess hard rock cavern stability, implementation of in-mine research on the response of domal salt, integrated laboratory and field study facilities to assess developed predictive methods and determine in situ response of a porous media reservoir to air injection are completed. DOE

N82-16548# Battelle Pacific Northwest Labs., Richland, Wash.
COMPRESSED-AIR ENERGY-STORAGE TECHNOLOGY: PROGRAM OVERVIEW
L. D. Kannberg Jul. 1981 7 p Presented at the Mech., Magnetic and Underground Energy Storage Ann. Contractor's Rev. Meeting, Washington, D.C., 24 Aug. 1981
(Contract DE-AC06-76RL-01830)
(DE81-030103; PNL-SA-9780; CONF-810833-8) Avail: NTIS HC A02/MF A01

A new technology designed to reduce the consumption of oil in the generation of electric power was developed. The program has two major elements: reservoir stability studies and second generation concepts studies. The reservoir stability studies are aimed at developing stability criteria for long term operation of large underground reservoirs used for compressed air storage. The second generation concepts studies are aimed at developing new concepts that will require little or no petroleum fuels for operation. The program efforts are outlined and major accomplishments towards the objectives of the program are identified. DOE

N82-16558# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
DESIGN AND ECONOMICS OF DIRECT-CONTACT SALT HYDRATE STORAGE SYSTEMS
John D. Wright May 1981 9 p refs Presented at the 2nd World Congr. of Chem. Eng., Montreal, 4-9 October 1981
(Contract EG-77-C-01-4042)
(SERI/TP-631-1163; CONF-811007-3) Avail: NTIS HC A02/MF A01

A salt hydrate latent heat storage system in which oil is injected at the bottom of the container and exhanges heat as it floats to the top where it is pumped back to the heat source is described. Two experiments are described: (1) to reliably inject the oil into the salt phase; and (2) to minimize the carryover of salt hydrate into the oil, which can be done using two stage coalescer filters. Three systems are described and compared: a standard liquid based sensible heat storage system, a latent heat storage design where oil is the heat transfer fluid throughout the system, and a latent heat storage system where ethylene glycol/water is used in the collectors and oil in the storage tank. DOE

N82-16579# Ames Lab., Iowa.
TRANSWALL: A MODULAR VISUALLY TRANSMITTING THERMAL STORAGE WALL Status Report
J. F. McClelland, R. W. Mercer, L. Hodges, R. F. Szydlowski, P. H. Sidles, R. G. Struss, J. R. Hull (Argonne National Lab., Ill.), and D. A. Block 1980 8 p refs Presented at the Intern. Solar Energy Soc. Conf., Brighton, England, 24-27 Aug. 1980
(Contract W-7405-eng-82)
(DE81-029821; IS-M-345; CONF-8008123-1) Avail: NTIS HC A02/MF A01

The Transwall a semitransparent thermal storage wall system that offers a number of advantages over conventional direct gain and Trombe wall approaches is examined. Progress is reported in the design, fabrication, installation, and operation of a glass and aluminum prototype system. A facility for year round performance testing of the system is described and preliminary summer season thermal test data are presented. Thermal performance modeing results that predict heat loss reduction with a heat mirror coating on Transwall to be comparable to that obtained with R6 night insulation are reported. DOE

N82-16584# Institut fuer Kerntechnik und Energiewandlung e.V., Stuttgart (West Germany).
DEVELOPMENT OF A MODULAR HEAT EXCHANGER WITH INTEGRATED LATENT HEAT ENERGY STORE Final Report, Dec. 1979
Ashok Abhat, Dietmar Heine, Manfred Heinisch, Nikolaus A. Malatidis, and Guenther Neuer Bonn Bundesministerium fuer Forschung und Technologie Feb. 1981 247 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(Contract BMFT-PLE-ET-4060-A)
(BMFT-FB-T-81-050; ISSN-0340-7608) Avail: NTIS HC A11/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 41,10

Latent heat storage materials and appropriate heat exchangers for solar heating applications, such as house heating and domestic hot water production were investigated. The melting and freezing characteristics and the effects of thermal cycling on a total of 12 substances, including paraffins, fatty acids and salt hydrates, were investigated and their corrosive interaction with five conventional construction materials was determined. The poor thermal conductivity of the heat storage materials requires the development of a modular finned heat pipe heat exchanger with increased heat transfer characteristics. A cost analysis is provided and comparisons with hot water storage indicate that latent heat storage has the potential of becoming economically more attractive than the former for domestic hot water production. Author (ESA)

08
GENERAL

A82-15377 **Research opportunities in new energy-related materials.** J. L. Warren (Los Alamos National Laboratory, Los Alamos, NM) and T. H. Geballe (Stanford University, Stanford, CA). *Materials Science and Engineering*, vol. 50, Oct. 1981, p. 149-198. 235 refs. Research supported by the U.S. Department of Energy.

The needs and opportunities in basic research on new materials are reviewed with a view to providing a basis for planning future research programs. The review covers polymers, intermetallic compounds, amorphous solids, thin films, solid state ionics, catalysts, and semiconductors. It is concluded that (1) a large number of new materials can be prepared by imaginative application of established techniques, (2) a close coupling of synthesis, characterization, and measurement of properties is essential, and (3) new phases of well-known materials, e.g. amorphous materials and thin films, provide a better understanding of these materials and promise solutions to a number of technical problems. V.L.

A82-17251 **Metallurgical coatings 1980; Proceedings of the Seventh International Conference, San Diego, CA, April 21-25, 1980. Volumes 1 & 2.** Conference supported by the Energy Research, Inc., High Vacuum Equipment Corp., Kinney Vacuum Co., et al. Edited by J. N. Zemel. Lausanne, Elsevier Sequoia, S.A., 1980. Vol. 1, 567 p.; vol. 2, 510 p. Price of two volumes, $129.75.

Among the topics discussed are: (1) metallurgical coatings for solar energy applications, such as highly reflecting molybdenum thin films, the nucleation and growth characteristics of zinc oxide overgrowths, and the oxidation of electrodeposited black chromium selective solar films; (2) the characterization of coating defects, including aluminum film vapors deposited onto plastic, plasma-sprayed ferrous alloys, and chemisorption monolayer coatings; (3) metal and alloy coatings, among which are those of tungstate on tin, molybdenum on graphite, aluminum-zinc coatings for the corrosion protection of steel and aluminum-silver alloy films for solar reflectors; (4) metallurgical aspects of microelectronics, including recent advances in solder bond technology for microelectronic packaging; (5) semiconductor and dielectric coatings; and (6) refractory compound coatings. O.C.

N82-10665# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
MEASURED PERFORMANCE OF FALLING-JET FLASH EVAPORATORS
H. J. Green, D. A. Olson, D. Bharathan, and D. H. Johnson Jun. 1981 9 p refs Presented at the 8th Ocean Energy Conf., Washington, D.C., 7 Jun. 1981
(Contract EG-77-C-01-4042)
(DE81-024355; SERI/TP-631-1270; CONF-810622-3) Avail: NTIS HC A02/MF A01

The rates of heat transfer and approach to thermal equilibrium of flash evaporators operating at pressures of 2 to 4 kPa were investigated. Heat and mass transfer rates from falling jet evaporators operating in the temperature range of 18 to 30 C are measured. The initial experimental results are given and the apparatus is described. DOE

N82-11012# Ames Lab., Iowa.
AMES LABORATORY RESEARCH REPORT, 1980
1980 100 p
(Contract W-7405-eng-82)
(DE81-027399; IS-4767) Avail: NTIS HC A05/MF A01

Some of the research activities at Ames Laboratory described include coal research, solar cells, solar space heating of buildings, superconducting wires, coal carcinogens, lasers, solid waste recovery, nuclear physics, and high energy physics. Publications are listed. DOE

N82-14849# California Univ., Livermore. Lawrence Livermore Lab.
FIRE-PROTECTION RESEARCH FOR ENERGY TECHNOLOGY: FY 80 YEAR END REPORT
H. K. Hasegawa, N. J. Alvares, A. E. Lipska, H. Ford, S. Pruente, and D. G. Beeson 26 May 1981 118 p refs
(Contract W-7405-eng-48)
(DE82-000970; UCRL-53179) Avail: NTIS HC A06/MF A01

This continuing research program was initiated in order to advance fire protection strategies for Fusion Energy Experiments (FEE). The program expanded to encompass other forms of energy research. Accomplishments for fiscal year 1980 were: finalization of the fault-free analysis of the Shiva fire management system; development of a second-generation, fire-growth analysis using an alternate model and new LLNL combustion dynamics data; improvements of techniques for chemical smoke aerosol analysis; development and test of a simple method to assess the corrosive potential of smoke aerosols; development of an initial aerosol dilution system; completion of primary small-scale tests for measurements of the dynamics of cable fires; finalization of primary survey format for non-LLNL energy technology facilities; and studies of fire dynamics and aerosol production from electrical insulation and computer tape cassettes. DOE

N82-14881# Strasbourg Univ. (France). Bureau d'Economie Theorique et Appliquee.
ECONOMIC EFFECTS INDUCED BY ESA CONTRACTS, PHASE 2. VOLUME 1: SUMMARY [LES EFFETS ECONOMIQUES INDUITS DES CONTRATS DE L'ESA. PHASE 2. VOLUME 1: RESUME]
Patrice Brendle, Patrick Cohendet, Jean-Alain Heraud, Regis LaruedeTournemine, Helwig Schmied, Daniel Vitry, and Ehud Zuscovitch Paris ESA Jun. 1980 22 p In FRENCH 3 Vol
(Contract ESA-3702/78/F-DKR(SC))
(ESA-CR(P)-1462-Vol-1) Avail: NTIS HC A02/MF A01

Different effects are classified by: technological advantages; commercial gains; organization and methodological advances; and impact on employment. Exports and limiting, or substitution for, imports are considered. Advantages other than space research were estimated for each sector of the economy and by country. Project Meteosat is shown to be of particular value. Results show that innovations due to ESA funding center on two essential activities: processing, storage and dissemination of information; and conditioning, storage and distribution of energy.
Author (ESA)

N82-15008* National Aeronautics and Space Administration, Washington, D. C.
HIGHLIGHTS OF 1981 ACTIVITIES
23 Dec. 1981 20 p
(NASA-News-Release-81-199; PB81-10203) Avail: NTIS Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22B

The highlights of NASA's 1981 activities are presented, including the results of the two flights of the space shuttle Columbia and the Voyager 2 encounter with Saturn. Accomplishments in the areas of space transportation operations; space science; aeronautical, energy, and space research and development; as well as space tracking, international activities, and 1981 launch activities are discussed. S.L.

N82-15436# National Bureau of Standards, Washington, D.C.
DIMENSIONS, VOLUME 65, NUMBER 3
Apr. 1981 29 p refs
(PB81-235053; NBS-DIM-65-3) Avail: NTIS HC A03/MF A01 CSCL 14B

This monthly magazine features short summaries of major technical developments, highlights of work in progress, major speeches and statements by Bureau management, and a listing of NBS publications. Topics discussed are issue swinging to the Earth's tilt, testing for technical competence, physics at the measurement limits, new parameter proposed for fracture toughness, evaluation of solar collector cover plates, and improved modeling of cement and concrete, fire development in basement rooms, and generation and measurement of DC electric field with space charges. Author

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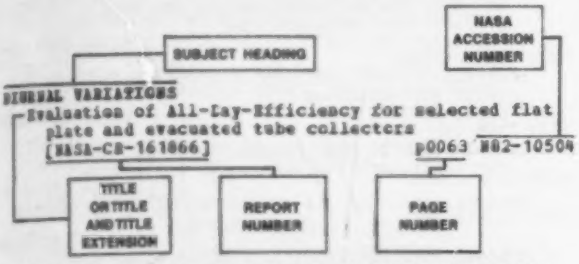

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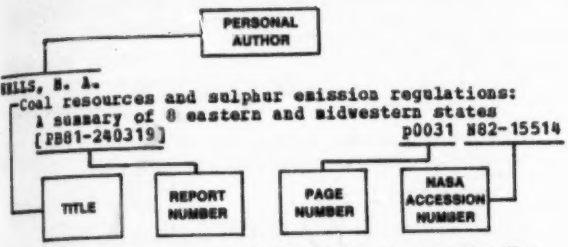

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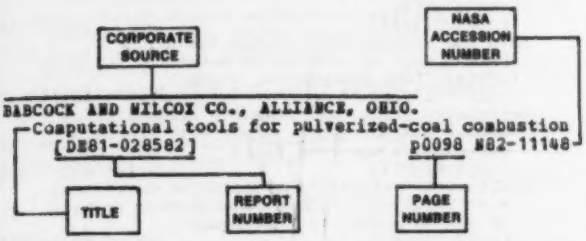

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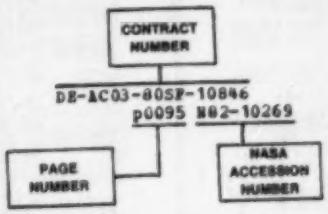

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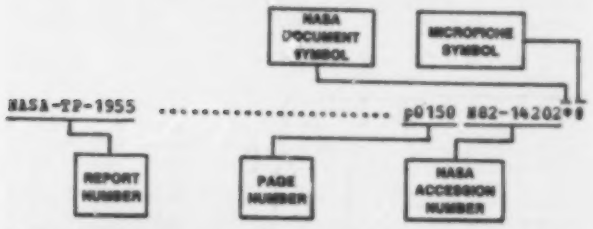

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AD-A104730 ..... p0111 N82-12735 #
AD-A105621 ..... p0027 N82-14071 #
AD-A105625 ..... p0029 N82-14875 #
AD-A105667 ..... p0113 N82-14317 #
AD-A105770 ..... p0150 N82-14638 #
AD-A105947 ..... p0143 N82-14642 #
AD-A106005 ..... p0076 N82-13514 #

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AEROCHEM-TR-219 ..... p0023 N82-13192 #

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AFWAL-TR-81-2063 ..... p0100 N82-11228 #

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AIAA PAPER 81-2531 ..... p0053 A82-14002*#
AIAA PAPER 81-2532 ..... p0053 A82-14003*#
AIAA PAPER 81-2533 ..... p0054 A82-14004 #
AIAA PAPER 81-2534 ..... p0054 A82-14005*#
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AIAA PAPER 81-2567 ..... p0003 A82-14024 #
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AIAA PAPER 81-2572 ..... p0129 A82-14029 #
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AIAA PAPER 81-2590 ..... p0130 A82-14038 #
AIAA PAPER 81-2592 ..... p0003 A82-14040 #
AIAA PAPER 81-2596 ..... p0136 A82-18220 #
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AIAA PAPER 82-0065 ..... p0061 A82-17762 #
AIAA PAPER 82-0066 ..... p0155 A82-17763 #
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AIAA PAPER 82-0377 ..... p0135 A82-17913 #
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AIAA PAPER 82-0394 ..... p0135 A82-17922 #
AIAA PAPER 82-0395 ..... p0135 A82-17923 #
AIAA PAPER 82-0423 ..... p0135 A82-17941*#
AIAA 81-2219 ..... p0002 A82-13457 #

ALO-4227-6 ..... p0081 N82-15551 #

ANL-81-14 ..... p0158 N82-11578 #
ANL-81-30 ..... p0100 N82-11169 #

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ANL/CNSV-TM-68 ..... p0011 N82-11317 #
ANL/CNSV-TM-76 ..... p0028 N82-14650 #
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ANL/CNSV-22 ..... p0101 N82-11244 #
ANL/ECS-TM-142 ..... p0014 N82-11644 #
ANL/ECS-TM-144 ..... p0105 N82-11573 #
ANL/ECS-TM-149 ..... p0010 N82-11245 #
ANL/ES-116 ..... p0104 N82-11518 #
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ANL/FR-81-57 ..... p0108 N82-12262 #

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AR-3 ..... p0118 N82-15509 #

ASME PAPER 81-HT-71 ..... p0121 A82-10958 #
ASME PAPER 81-HT-80 ..... p0089 A82-10965 #
ASME PAPER 81-HT-81 ..... p0083 A82-10966 #
ASME PAPER 81-HT-83 ..... p0083 A82-10968 #
ASME PAPER 81-SOL-1 ..... p0041 A82-10969 #
ASME PAPER 81-SOL-2 ..... p0041 A82-10970 #
ASME PAPER 81-SOL-3 ..... p0041 A82-10971 #
ASME PAPER 81-SOL-4 ..... p0042 A82-10972 #
ASME PAPER 81-SOL-5 ..... p0042 A82-10973 #

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B-101-3 ..... p0110 N82-12595 #

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BM-OFR-94(3)-81 ..... p0014 N82-11652 #

BM-RI-8538 ..... p0026 N82-13489 #

BM-SP-5-81 ..... p0112 N82-13488 #

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DAFT-FB-T-80-076 ..... p0097 N82-10482 #
DAFT-FB-T-80-100 ..... p0017 N82-12403 #
DAFT-FB-T-80-109 ..... p0032 N82-15583 #
DAFT-FB-T-80-125 ..... p0020 N82-12641 #
DAFT-FB-T-80-133 ..... p0066 N82-10571 #
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DAFT-FB-T-80-189 ..... p0016 N82-12205 #
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DAFT-FB-T-81-047 ..... p0143 N82-14666 #
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DAFT-FB-T-81-082 ..... p0080 N82-15529 #
DAFT-FB-T-81-097 ..... p0080 N82-15530 #
DAFT-FB-T-81-099 ..... p0030 N82-15367 #
DAFT-FB-T-81-101 ..... p0080 N82-15532 #
DAFT-FB-T-81-102 ..... p0029 N82-15142 #
DAFT-FB-T-81-111 ..... p0119 N82-15656 #
DAFT-FB-T-81-138 ..... p0150 N82-15134 #
DAFT-FB-T-81-154 ..... p0080 N82-15537 #
DAFT-FB-T-81-156 ..... p0080 N82-15538 #
DAFT-FB-T-81-165 ..... p0080 N82-15541 #
DAFT-FB-T-81-168 ..... p0030 N82-15168 #

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DNL-22952 ..... p0033 N82-15609 #
DNL-29281 ..... p0086 N82-11257 #
DNL-29461 ..... p0086 N82-14382 #
DNL-29520 ..... p0087 N82-15220 #
DNL-29592 ..... p0012 N82-11414 #
DNL-29666 ..... p0069 N82-11575 #
DNL-29677 ..... p0067 N82-11413 #
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DNL-29680 ..... p0070 N82-11584 #
DNL-29720 ..... p0013 N82-11589 #
DNL-29747 ..... p0020 N82-12637 #
DNL-29751 ..... p0031 N82-15543 #
DNL-29764 ..... p0114 N82-14381 #
DNL-29773 ..... p0114 N82-14379 #
DNL-29857 ..... p0035 N82-16014 #
DNL-29881 ..... p0021 N82-12842 #
DNL-29900 ..... p0150 N82-13517 #
DNL-29932 ..... p0150 N82-15338 #
DNL-29953 ..... p0119 N82-15604 #
DNL-29970 ..... p0081 N82-15571 #
DNL-51321 ..... p0093 N82-10153 #
DNL-51370 ..... p0157 N82-11368 #
DNL-51394 ..... p0072 N82-12600 #
DNL-51423 ..... p0108 N82-12255 #

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CONF-800436 ..... p0006 N82-10277 #
CONF-800608-8 ..... p0009 N82-10598 #
CONF-800612-6 ..... p0157 N82-10962 #
CONF-800617-8 ..... p0137 N82-10553 #
CONF-800716 ..... p0114 N82-14374 #
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CONF-8106152-1 ..... p0097 N82-10655 #
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DFVLR-FB-81-07 ..... p0136 N82-10452 #

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DOE/AF-92005/T1 ..... p0100 N82-11235 #
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DOE/BETC/PPS-81/3 ..... p0117 N82-15224 #
DOE/BETC/QPR-80/4 ..... p0094 N82-10250 #
DOE/BP-58 ..... p0142 N82-13519 #
DOE/BP-60 ..... p0112 N82-13518 #
DOE/CE-0016 ..... p0031 N82-15554 #
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DOE/ET-12056/25 ..... p0098 N82-11153 #
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16. Abstract

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(34)) lists 1015 reports, journal articles, and other documents announced between April 1, 1982 and June 30, 1982 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The entries are arranged in eight major categories, with *IAA Entries* preceding *STAR Entries* in each category. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

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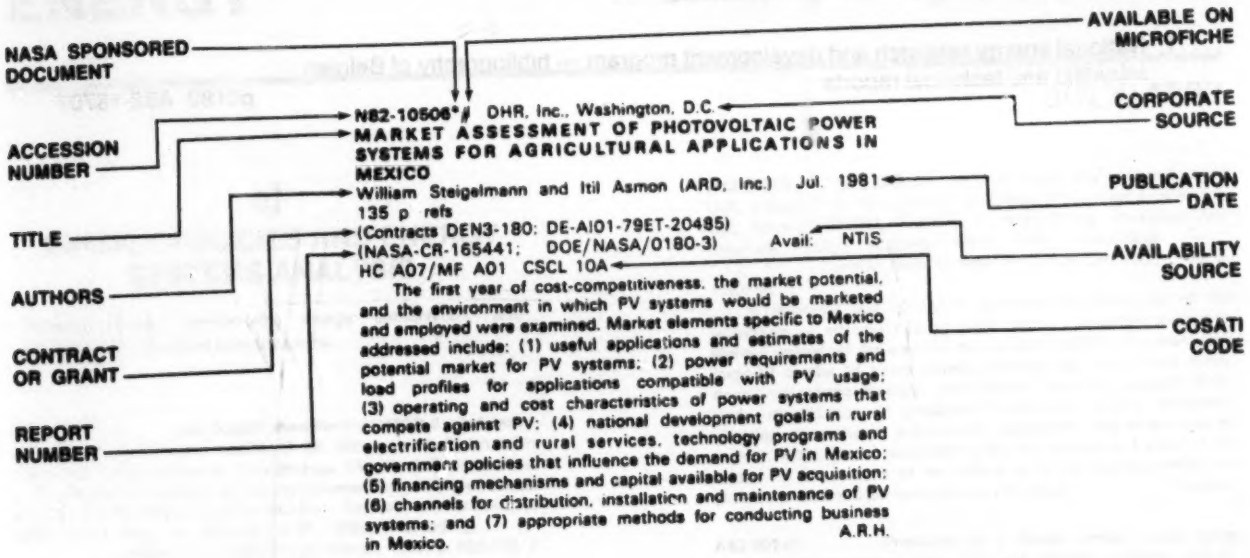

N82-10506*# DHR, Inc., Washington, D.C.
MARKET ASSESSMENT OF PHOTOVOLTAIC POWER SYSTEMS FOR AGRICULTURAL APPLICATIONS IN MEXICO
William Steigelmann and Itil Asmon (ARD, Inc.) Jul. 1981
135 p refs
(Contracts DEN3-180; DE-AI01-79ET-20485)
(NASA-CR-165441; DOE/NASA/0180-3) Avail: NTIS
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The first year of cost-competitiveness, the market potential, and the environment in which PV systems would be marketed and employed were examined. Market elements specific to Mexico addressed include: (1) useful applications and estimates of the potential market for PV systems; (2) power requirements and load profiles for applications compatible with PV usage; (3) operating and cost characteristics of power systems that compete against PV; (4) national development goals in rural electrification and rural services, technology programs and government policies that influence the demand for PV in Mexico; (5) financing mechanisms and capital available for PV acquisition; (6) channels for distribution, installation and maintenance of PV systems; and (7) appropriate methods for conducting business in Mexico.

A.R.H.

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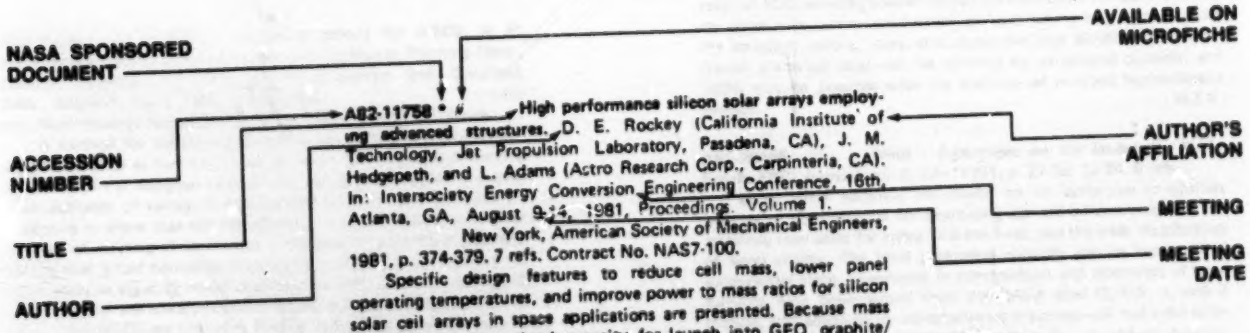

A82-11758 * # High performance silicon solar arrays employing advanced structures. D. E. Rockey (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), J. M. Hedgepeth, and L. Adams (Astro Research Corp., Carpinteria, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 374-379. 7 refs. Contract No. NAS7-100.

Specific design features to reduce cell mass, lower panel operating temperatures, and improve power to mass ratios for silicon solar cell arrays in space applications are presented. Because mass constraints limit payload capacity for launch into GEO, graphite/epoxy structures combined with high performance Si cells are needed to deliver a power/mass ratio of 265 W/kg, notably for Solar Electric Propulsion systems, compared with existing level of 65 W/kg. Shallow diffusion and back surface field cell technology have raised cell efficiencies to 15%, with a back emissivity of 1.64. Structural design requirements comprise Shuttle interface compatibility, full ground test capability, low mass, and high stiffness. Three array alternatives are discussed, and the STACBEAM configuration, which consists of a triangular truss and a piston deployer with folding accomplished on simple hinges, provides 0.2 Hz stiffness and achieves the design power/mass goals.

D.H.K.

A Listing of Energy Bibliographies Contained in This Publication:

1. National energy research and development program --- bibliography of Belgian scientific and technical reports p0182 A82-18707

01
ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Includes energy requirements, energy conservation, and environmental impacts of energy systems.

A82-19053 # An impact assessment of MOD-2 wind generators on the TVA power system. D. W. Hilson, N. D. Sadanandan (Tennessee Valley Authority, Chattanooga, TN), H. M. Sendaula, and R. R. Johnson (Tennessee, University, Chattanooga, TN). In: Annual Allerton Conference on Communication, Control, and Computing, 18th, Monticello, IL, October 8-10, 1980, Proceedings. Urbana, IL, University of Illinois, 1980, p. 196-205. 7 refs. Contract No. DE-AI01-79ET-23077.

The impact of significant amounts of wind generation on the daily operations of an electric power system is currently being investigated by the Tennessee Valley Authority (TVA) under sponsorship of the Department of Energy. This paper describes the characteristics and daily operations of the TVA system without wind, and summarizes the preliminary findings when simulating a reconfiguration of the transmission system to accommodate wind generation. The ongoing activities for simulation and analysis of the operation of the TVA system with wind generation are also briefly outlined. (Author)

A82-19112 System economic theory for WECS. A. P. Rockingham (Central Electricity Generating Board, Planning Dept., London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 109-117. 6 refs.

A method for evaluating the design of wind energy conversion systems (WECS) as fuel and capacity savers for utilities is presented. A criteria of the marginal value of the WECS to the system is chosen as an indicator of savings in total system expense. Cost polygons are employed to show that the net effective cost is at a minimum when the cost of meeting an increment in demand at peak hour is lowest. Noting that actual operating experience with WECS is necessary for the validity of capacity credit analyses, the difficulties in maintaining optimum heat use loads in conventional plants due to fluctuations of input from WECS are outlined. Finally, it is shown that the cost of added WECS plants will decline as the number of WECS decreases, while the total capacity and the cost of power will remain the same. M.S.K.

A82-19118 The Hull wind powered housing project. D. C. Hodges (Hull College of Higher Education, Hull, Yorks., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 163-172.

This paper will describe a proposed scheme in Hull to utilize a medium scale wind generator to provide a large portion of the space and water heating requirements for a group of 32 highly insulated local authority houses. The proposed system to achieve this will be described, followed by analysis of the advantages of such systems and an estimate of their possible application. (Author)

A82-19119 Offshore siting of wind turbine generators in U.K. waters. P. B. Simpson and D. Lindley (Taywood Engineering, Ltd., Southall, Middx., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 173-185.

A technical and economic assessment is described of the generation of electricity using wind turbine generators located in shallow waters off the coast of the United Kingdom. The assessment involved studies of siting criteria, meteorology, sea surface conditions, engineering geology, construction materials, support structures, marinisation of complete installations, cluster efficiency, electrical transmission and control, availability and environmental aspects. Estimates of generation costs are quoted and some of the results of an analysis of the influence of various parameters on generation cost and performance are described. (Author)

A82-20141 Potential for a Danish power system using wind energy generators, solar cells and storage. S. Blegaa and G. Christiansen (Danmarks Tekniske Hojskole, Lyngby, Denmark). *International Journal of Ambient Energy*, vol. 2, Oct. 1981, p. 223-232. 9 refs.

Performance characteristics of a combined solar/wind power system equipped with storage and an unspecified back-up power source are studied on the basis of meteorological data in Denmark from 1959-1972. A model for annual production and storage from wind/solar installations is presented, assuming 12% efficiency for the solar cells and various power coefficients of the windmills, in addition to long and short-term storage. Noting that no correlation between wind and solar energy availability was found, and a constant ratio of 60% wind/40% solar was determined to be the optimum mix for large scale power production without taking into consideration the variations among years. It is concluded that 80-90% of the total Danish electrical load can be covered by solar/wind systems, and 100% may be possible with the addition of pumped hydroelectric storage. M.S.K.

A82-20166 Wind - Prototypes on the landscape. M. L. Smith. *EPRI Journal*, vol. 6, Dec. 1981, p. 27-30, 32-34. 6 refs.

Large wind turbines are shown to be attractive to utilities because of the potential for decreasing gas and oil consumption, the relatively low costs for entry into the field, and the wide distribution of wind energy. The total generating capacity can be increased in incremental steps, experience in construction and operation of large turbines have been gained from the NASA Mod O, OA, 1, and 2 models, and advances in manufacturing processes will make the large turbines competitive as replacement power for oil and gas burning utility generators. The 300 ft rotor Mod 2 machines are described, along with designs for the Mod 5A and Mod 5B wind turbines, with 400 and 422 ft, 6.2 and 7.2 MW rotors and outputs, respectively. Current plans for multi-MW windfarms are reviewed, and the option of using the land around large wind turbines for other purposes is stressed. M.S.K.

A82-20207 # Advantages of permanent magnet VSCF generating systems on aircraft fuel economy. J. J. O'Neill (General Electric Co., Aircraft Equipment Div., Binghampton, NY). *Journal of Energy*, vol. 6, Jan.-Feb. 1982, p. 34-37. 8 refs. USAF-sponsored research.

Permanent magnet aircraft electrical generating systems offer many advantages to both the aircraft designer and the user. These systems are typically smaller, lighter, and more reliable. Another

advantage, which until recently has been overlooked, is the higher efficiency of this type of system. This paper examines the effect of the higher efficiency on aircraft fuel consumption. Data for several system sizes are presented as well as several techniques for calculating such parameters as differential power extraction, cost savings per hour, and total cost savings. (Author)

A82-20513 Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1981. 77 p.

Topics discussed include design possibilities for improved fuel efficiency of civil transport aircraft, energy management in military combat aircraft, and the control of aircraft gas turbines for fuel economy. Particular attention is given to the impact of increasing cost upon the design of avionic fuel management systems and the operational and performance aspects of fuel management in civil aircraft. Consideration is also given to the FS2 Bedford Civil Flight Research Program as well as current and future developments in thrust management. J.F.

A82-20514 Design possibilities for improved fuel efficiency of civil transport aircraft. D. H. Jagger (Airbus Industrie, Blagnac, Haute-Garonne, France). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 9 p.

The possible application and potential benefits of various technical advances in aerodynamics, structures, and propulsion for the reduction of fuel usage in future Airbus aircraft are discussed. In particular, technical comparisons and tradeoffs in terms of fuel economy are considered for a hypothetical medium-range project aircraft of the 1980's. Improvements in fuel used per passenger at 1,000 n.m. range over two successive periods of 20 years are estimated. A breakdown of the objectives, time-scales, and costs of various parts of the current NASA Aircraft Energy Efficiency Program is also given. This features such improvement as propulsion/aerodynamic integration winglets, the use of advanced composite materials, drag cleanup, structural-duct integration, minimum suction-natural laminar flow, reduction of engine performance losses, and active controls for load alleviation. J.F.

A82-20515 Energy management in military combat aircraft. J. W. Lyons (British Aerospace Public, Ltd., Co., Aircraft Group, Brough, Humberside, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 6 p. 5 refs.

Energy management is important not only for fuel economy, but for efficient three-dimensional maneuvering capabilities as well. The principles of several new techniques for energy efficient three-dimensional maneuvers in combat aircraft are discussed. Efficient turbofan engines have been adopted which are electronically controlled for achieving precise thrust settings within engine limits. Engine bleed can be better controlled, and hydraulic pressure control, resulting in reduced mechanical offtakes from the engine, is now possible using microprocessors. Self-healing systems can be used in the battlefield scenario, and advanced display concepts are being employed to make better use of available maneuver energy. These techniques individually result in greater efficiency, but together they provide significant synergistic improvements. J.F.

A82-20516 The control of aircraft gas turbines for fuel economy. D. J. Lee (Rolls-Royce, Ltd., Bristol, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 7 p.

Electronic controls are important to the fuel efficient aircraft of the future as sophisticated fly by wire controls, flight management systems, and complex ATC navigation systems. The functions obtainable using electronic controls are often more complex and more flexible than those produced with hydromechanical systems. They provide greater accuracy in staying within temperature and stress limitations, as well as increased fuel economy. Electronic engine control is also very cost effective over the life of the unit and has the benefit of reducing the pilot workload. Microprocessors have made the use of digital technology for engine control more popular; the benefits of digital control may be seen in terms of improved accuracy, fault diagnostics and tolerance, fuel-type variations, system complexity, and airframe integration. Finally, engine health monitoring systems are used for the programmed maintenance of mechanical parts of gas turbines. J.F.

A82-20517 The impact of increasing energy costs upon the design philosophy of avionic fuel management systems. P. R. Thrift (Smiths Industries Aerospace and Defence Systems Co., London, England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 9 p.

Parameters of fuel quantity remaining and rate-of-usage are determinate factors in the operational range of any aircraft. Methods for designing engines with lower fuel consumption, and airframes with lower drag coefficients to minimize the mass of fuel to be carried are being investigated. Operating costs may be reduced by using unused portions of fuel as dynamic balast to control the center of gravity throughout a flight profile. Fuel consumption can also be reduced by control of the aircraft's complete flight envelope. Strategies for measuring fuel mass and determining fuel density are discussed. Means of improving the twin concentric circular cross section transducers are discussed, and the production of a fault tolerant system by the incorporation of two computer systems is described. Finally, the use of microprocessors to control the center of gravity and to detect fuel leaks is discussed. J.F.

A82-20518 Operational and performance aspects of fuel management in civil aircraft. H. P. K. Dibley (British Airways, Hounslow, Middx., England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 13 p.

In order to carry maximum payload at minimum cost, an airline must find means of optimizing fuel purchasing, pre-flight planning, and in-flight procedures. Accurate forecasting and monitoring of fuel costs is needed to obtain adequate fuel supplies at the best price, to maximize uplift at cheap stations, and to show the effect of outages of uplift stations. Pre-flight planning is used to determine the route for minimum fuel consumption and to calculate the maximum take-off weight. Minimization of fuel consumption during flight can be achieved by (1) presentation of optimum climb, cruise and descent information; (2) flight management systems coupled to the autopilot; (3) optimizing the use of engine climb derate; (4) improving navigational accuracy; (5) presentation of more navigation parameters to the pilot; (6) vertical navigation; and (7) minimizing noise and fuel consumption on approach. J.F.

A82-20520 Thrust management - Current achievements and future developments. J. L. Weston (Smiths Industries Aerospace and Defence Systems Co., Cheltenham, Glos., England). In: Energy management and its impact on avionics; Proceedings of the Symposium, London, England, March 19, 1981. London, Royal Aeronautical Society, 1981. 12 p.

A system architecture has been developed to provide a fuel efficient full-flight regime auto-throttle system and a second generation flight management computer system. The auto-throttle system is capable of controlling the engine throttle levers from before take-off until touchdown as well as providing command signals to the aircraft flight director system. The operation modes of the system include take-off, climb, cruise, descent, maximum continuous thrust, hold, approach and go-around. The flight management computer system is responsible for the overall operation of the aircraft between the take-off location and the destination point. Its eight major functions are (1) flight planning; (2) navigation; (3) control of VOR/DME receivers; (4) lateral guidance; (5) vertical path optimization; (6) vertical guidance; (7) look ahead information; and (8) provision of information to support the electronic flight instrument system. J.F.

A82-20644 Environmental effects of the Satellite Power System Microwave Power Transmission System. A. R. Valentino

(Argonne National Laboratory, Argonne, IL) and M. M. Abromavage (IIT Research Institute, Chicago, IL). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 3.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 48.5.1-48.5.4.

The potential environmental effects of the Satellite Power System (SPS) Microwave Power Transmission System (MPTS) have been studied as a part of the SPS Concept Development and Evaluation Program (CDEP). A number of issues have been identified including: health effects due to microwave exposure for the public as well as the SPS worker; effects on telecommunications due to ionospheric changes caused by the passage of the microwave beam; and electromagnetic compatibility with military systems, radio astronomy, satellite systems, and electronic systems in general. Assessments have been prepared based on existing data, and none of the issues precludes the continued study of SPS technology. To increase the certainty of the assessment, some research has been initiated and long-term research is being planned. (Author)

A82-20757 **General aviation fuel consevation in the 1980's.** G. R. Bromley (Beech Aircraft Corp., Wichita, KS). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980.
Lancaster, CA, Society of Flight Test Engineers, 1980, p. 9-1 to 9-22.

Techniques for conserving fuel in-flight are given from a flight engineer's point-of-view, noting that aircraft designs will increasingly incorporate cleaner aerodynamics and better engine-to-airframe matching. The effects of wind and temperature at various altitudes and fuel consumption in ascent and descent are considered, and methods for determining maximum range airspeeds are developed, particularly for choosing long-range cruise airspeeds. Specific charts are presented for private pilots in general aviation aircraft, relating wind, no-wind, and tailwind conditions as regards to fuel consumption. M.S.K.

A82-20764 **A study of the suitability of the all fiberglass XV-11A aircraft for fuel efficient general aviation flight research.** G. Bennett (Mississippi State University, Mississippi State, MS). In: Flight testing in the eighties; Proceedings of the Eleventh Annual Symposium, Atlanta, GA, August 27-29, 1980.
Lancaster, CA, Society of Flight Test Engineers, 1980, p. 18-1 to 18-15. 8 refs.

The impact of rapidly rising fuel prices upon future general aviation aircraft requirements is explored. The current configuration of the fiberglass XV-11A aircraft is presented and it is shown that the aircraft can become a cost effective testbed for fuel efficient general aviation aircraft configurations. Several suitable research tasks for the aircraft are defined. A low cost method to produce master wing molds is proposed. (Author)

A82-20874 * # **Advanced subsonic transport propulsion.** D. L. Nored, C. C. Ciepluch, R. Chamberlin, E. T. Meleason, and G. A. Kraft (NASA, Lewis Research Center, Cleveland, OH). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, NJ, May 26-28, 1981, AIAA Papar 81-0811.* 30 p. 5 refs.

Examination of future subsonic commercial aircraft propulsion trends begins with a brief review of the current NASA Energy Efficient Engine (E3) Project. Included in this review are the factors that influenced the design of these turbofan engines and the advanced technology incorporated in them to reduce fuel consumption and improve environmental characteristics. In addition, factors such as the continuing spiral in fuel cost, that could influence future aircraft propulsion systems beyond those represented by the E3 engines, are also discussed. Advanced technologies that will address these influencing factors and provide viable future propulsion systems are described. And finally, the potential importance of other propulsion system types, such as geared fans and turboshaft engines, is presented. (Author)

A82-21225 **Renewable energy - Target for 2050.** W. D. Rowe (American University, Washington, DC). *IEEE Spectrum,* vol. 19, Feb. 1982, p. 58-63. 10 refs.

The possibilities of various renewable energy technologies to supply a projected world demand for 40,000 GW years of energy each year by the year 2050 are examined. Noting that industrial processes consume 50% of all energy needs, fossil fuel reserves are shown to be sufficient for a maximum of 370 yr in the U.S., when all supplies become depleted. Breeder reactors have a doubling time which is 30 yr too long for meeting more than 0.5% of world energy demand in 2050, while fusion, even considering ocean-derived deuterium as a fuel source, will not be supplying energy for another 35-70 yr. Among the solar technologies, the installation of ten million 100 m tall 4 MW wind generators is feasible to meet all the projected energy needs, and solar cells with 10% conversion efficiency could do the same with 14 times less land. Further discussion is given to geothermal, fuel cell, and OTEC technologies, as well as the forty trillion dollars necessary to erect the fully renewable systems. M.S.K.

A82-21362 **Government-industry relationships in technology commercialization - The case of photovoltaics.** J. D. Roessner (Georgia Institute of Technology, Atlanta, GA). *Solar Cells,* vol. 5, Jan. 1982, p. 101-134. 34 refs. NSF-supported research.

Interfaces between the U.S. government and the emerging photovoltaics industry are examined in terms of basic research programs, market studies, and strategies to accelerate the development of the industry. The process of the development of a model industry is outlined from innovation to large-scale, specific use production, and DOE programs are noted to shift from R and D, testing, and evaluation programs to market tests, demonstrations, and workshops when a product becomes commercially ready. The growth of funding for research, technology development, and purchases to gain operational experience with solar cell arrays is traced, and it is noted that firms specializing in photovoltaics production have managed to continue with irregular government funding and normal, private financing arrangements. Government procurement is suggested to have the greatest impact on a new industry, especially when coupled with performance and reliability requirements. M.S.K.

A82-21373 * # **We have just begun to create efficient transport aircraft.** D. J. Maglieri and S. M. Dollyhigh (NASA, Langley Research Center, Aeronautical Systems Div., Hampton, VA). *Astronautics and Aeronautics,* vol. 20, Feb. 1982, p. 26-38. 21 refs.

Factors affecting the cost-effectiveness and economics of the air transportation industry are reviewed. The delivery of more fuel-efficient aircraft and eventual total replacement in the 1990's by fleets of advanced aircraft are seen to offset rising fuel costs. Better airport operations are perceived to eliminate fuel-costly delays due to overcrowded runways, lack of available carriers, and maintenance of aircraft in holding patterns. Noise reduction research will lower the lawsuit costs from noise pollution, and the introduction of advanced turbofans for long, short, and medium range flights, advanced commuter planes, and advanced SSTs offering projected 50% increases in current aircraft efficiencies are seen to be limited only by the airlines' ability to provide purchase financing, rather than by a lack of available new technology. M.S.K.

A82-22097 # **Testing of the low mass flow test train in the DOE Coal Fired Flow Facility.** G. D. Smith, R. J. Schulz, and N. R. Johanson (Tennessee, University, Tullahoma, TN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0378.* 12 p. 7 refs. Contract No. DE-AC02-79ET-10815.

The initial shakedown testing and evaluation of The Department of Energy (DOE) Coal Fired Flow Facility and the Low Mass Flow Magnetohydrodynamic Test Train are described. The testing included system and component performance determination and initial evaluation of the NO(x) relaxation through the flow train and SO2 level existing in the exhaust. Satisfactory performance was obtained from the facility systems and flow train components including the vitiation heater, coal fired combustor, radiant slagging furnace and secondary combustor. The effect of primary stoichiometry and N/O ratio on NO(x) levels throughout the flow train was clearly demonstrated. The exhaust stack NO(x) and SO2 levels for coal-fired operation are shown to be well below current EPA limits. Heat flux and wall static pressure distributions along the flow train are

presented and were found to be consistent with previous experience in a smaller research facility. The facility is operational as a test facility for coal and oil fired combustion systems and is capable of operation over a range of conditions from 100% coal to 100% fuel oil or any combination of coal/fuel oil mixture. (Author)

A82-24025 **Air transport in the 21st century.** K. G. Wilkinson. *Aerospace* (UK), vol. 9, Jan. 1982, p. 18-23. 8 refs.

Trends in aircraft design into the 21st century are discussed, based on the driving need for higher fuel efficiency and alternative fuels. Noting that fuel presently accounts for 30% of air transportation, results of an international study on the world energy supply and growth are used to present several scenarios of future aerospace operations. Global energy is projected to be provided from renewables and nuclear, coal and gas, and oil, each group producing 1/3 of the world energy demands, with aerospace consuming 3% of the total oil consumed. Advances in aerodynamics from NASA studies, in lightweight synthetic materials, in active controls, and in propulsion systems are outlined, with mention made of the CO2 contribution to a global rise in temperature. The development of nuclear technology and the availability of nuclear fuels is contrasted against the environmental costs of using hydrocarbon fuels, and the necessity of developing a hydrogen-based fuel economy is emphasized. M.S.K.

A82-24075 # **Stack gases desulphurization recovery processes in thermal power plants of the world. III - Processes based on absorption by solid materials.** S. Kumar (Banaras Hindu University, Varanasi, India). *Indian Journal of Environmental Protection*, vol. 1, July 1981, p. 162-165. 17 refs.

A review of processes involving entrained contactor systems and efficient dust recovery equipment for desulfurization recovery in the stacks of thermal power plants is presented. The alkalized alumina process involves the contact of the stack gas with the absorber in an entrained solid reactor at high temperature. The removal of SO2 occurs from 130-330 C by means of alkalized alumina with an active ingredient of sodium oxide. The DAP-Mn process comprises an absorption tower for the stack gases and a magnesium oxide absorber. Manganese sulphate is formed in the tower for collection in a multicyclone collector or an electrostatic precipitator. The absorber is later recycled. The Grillo process has an absorbent deposited on a carrier such as coke and contacted with stack gas in a moving bed absorber. Finally, the Sill process is examined for the absorber contact in an entrainment reactor, using high-calcium lignite ash for an absorber. M.S.K.

A82-24304 **Fuel-efficient windshields for transport, commuter and business aircraft.** G. L. Wiser (Sierracin Corp., Sylmar, CA). In: Conference on Aerospace Transparencies, London, England, September 8-10, 1980, Proceedings. London, Society of British Aerospace Companies, Ltd., 1981, p. 25-95. 34 refs.

The effects of weight and drag reduction measures involving windshields and their associated structures and systems on fuel efficiency are explored. It is shown that the incorporation of these techniques can save up to 80,000 gallons of fuel/year per aircraft in wide-body commercial aircraft applications, and 12,000 gallons/year per aircraft in the case of commuter designs. The alternatives considered include (1) flat glass windshields, (2) curved glass windshields, (3) curved high-strength glass windshields, (4) structurally-integrated curved windshields, (5) curved stretched acrylic windshields, (6) curved, chemically-strengthened glass windshields, and such associated systems as temperature controllers and rain removal. O.C.

A82-24394 **Management of powerplant maintenance and restoration programs for fuel conservation.** C. Reid (General Electric Co., Fairfield, CT). *Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 5-8, 1981, Paper 811052.* 15 p.

Powerplant operational and maintenance procedures are reviewed to minimize fuel consumption and total operating costs of existing large turbofan engines. Recommendations are made to reduce the rate of on-wing performance deterioration and to define cost effective performance refurbishment. Measures being taken to increase fuel and cost savings include the development of performance diagnostic/analytical systems to permit better management control of engine operating costs. On-wing performance retention can be improved by the observance of line maintenance and operational procedures minimizing the impact of the major causes of performance deterioration, such as increased clearances, erosion, contamination and leakage. D.L.G.

A82-24395 **Airline fuel saving through JT9D engine refurbishment.** J. W. Allison and D. R. Weisel (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). *Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 5-8, 1981, Paper 811051.* 12 p.

Since the JT9D engine entered airline service in 1970, increase in the price of jet fuel made it imperative to devise refurbishment procedures for in-service engines to improve their fuel economy. Developments leading to performance recovery and improvement of the engine are related to fan leading edge rework, and the one degree open first stator. Factors responsible for engine performance recovery and retention include also operational procedures, test configuration, and prevention of aircraft system pneumatic leakage. Attention is given to the fan strip panel concentric grinding tool, a properly repaired combustor with recently developed 'S-16' fuel nozzles, recommended refurbishment additions, operational procedures to maximize performance retention, a test configuration, and inspection techniques. G.R.

A82-24604 # **Magnetohydrodynamics and its hazard assessment.** W.-T. Chan. *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Saf-3.* 7 p. 34 refs. Members, $2.00; nonmembers, $4.00. Research supported by the Montana Energy and Magnetohydrodynamics Research and Development Institute.

Potential occupational and environmental hazards of a typical combined open-cycle MHD/steam cycle power plant are critically assessed on the basis of direct/indirect research information. Among the potential occupational hazards, explosion at the coal feed system or at the superconducting magnet; combustor rupture in a confined pit; high intensity dc magnetic field exposure at the channel; and combustion products leakage from the pressurized systems are of primary concern. While environmental emissions of SO(x), NO(x) and fine particulates are considered under control in experimental scale, control effectiveness at high capacity operation remains uncertain. Gaseous emission of some highly toxic trace elements including radioactive species may be of concern without gas cleaning device in the MHD design. (Author)

A82-24683 **The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980.** Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 192 p. Members, $22.50; nonmembers, $30.

Technical and economic problems were addressed for developing technologies which hold promise for replacing world demand for oil based fuels. Monitoring and analysis of conservation measures were discussed, along with new sources of fossil fuels, and energy from OTEC and fusion power plants. Geothermal plant siting, construction, and operation were examined, and MHD prototype plants were described. The applications and social effects of energy storage systems were explored, along with biomass potentials and methods, solar thermal energy systems, and topics relevant to fission reactor power systems. Finally, the development and assessment of fuel cells for commercial and utility applications were described, and IEEE position papers were presented on reactors, safety, cogeneration, SPS, and solid waste energy sources. M.S.K.

A82-24686 **OTEC power system development and environmental impacts.** N. F. Sather (Argonne National Laboratory, Argonne, IL). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 50-55. 6 refs.

The costs, materials, maintainability, and environmental impacts of prospective OTEC plants are reviewed, along with developmental time tables. The plants are noted to cost almost three times per KW

installed power as conventional coal or nuclear plants on land, with main expenses derived from the massive heat exchangers, which must necessarily be 500 times the size of those in conventional power plants. The issue of biofouling in the heat exchangers is addressed, and mechanical scrubbers, recirculating sponge balls, and low-level chlorination are suggested as possible solutions. A 10-40 MW installation is projected to be completed by 1984, and is intended for confirming the validity of OTEC concept for large-scale power generatinn, to test the methods of preventing biofouling, and to establish monitoring instrumentation for avoiding ammonia leaks from the working cycle into the ambient ocean. M.S.K.

A82-24687 **Geothermal resource field development.** T. Amor (Thermal Power Co., San Francisco, CA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 71-73.

The procedures for siting, constructing, and maintaining geothermal power plants are examined, with regard for the economic and environmental parameters. An initial survey involves leasing 10,000 acres of land to drill wells to depths of 5000-7000 feet in search of 340-400 F heat in the form of water or steam. The first well costs from $700,000-1,200,000, and is required to yield a steam flow rate of 100,000 lb/hr to indicate economic feasibility. Generating units are chosen in the 20-55 MW range, and in the case of the Geysers Project 15 wells delivering two million lb/hr are used to drive 110 MW generating units, each installation costing $20,000,000. Fluids are reinjected into the substrate to prevent subsidence of the land around the site and may actually extend the life of the resource. Problems with hydrogen sulfide abatement techniques are noted to decrease plant efficiencies and have not been solved. M.S.K.

A82-24688 **Geothermal direct use projects.** E. G. DiBello (EG & G Idaho National Engineering Laboratory, Idaho Falls, ID). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 75-79.

The history of direct use of geothermal resources is presented, along with an outline of current U.S. based programs. Geothermal fluids have been used to evaporate mineralized water to produce boric acid, for health and bathing, and for district heating. Current programs target applications in agriculture, for fish farming, grain drying, greenhouse heating, soil heating, mushroom growing, and animal husbandry. Industrial uses include timber and diatomaceous earth drying, mineral extraction, dehydration, cement slab curing, pulp and paper processing, and ethanol production. Projects are being monitored for environmental effects, resource assessment, well drilling and evaluation, corrosion, water disposal methods, system design and construction, and operational characteristics. Costs for the heat have been found to span the range of $.45-5.55/GJ, dependent on well depth and temperature, and space heating, commercial processing, and greenhouse heating systems are examined. M.S.K.

A82-24689 **Description of the DOE Coal-Fired MHD Flow Facility /CFFF/.** J. B. Dicks, J. F. Martin, J. W. Muehlhauser, and S. S. Strom (Tennessee, University, Tullahoma, TN). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 81-85.

Components, instrumentation, and operating parameters of the DOE MHD Coal-Fired Flow Facility are described, noting its extension and expansion from a previous prototype plant. The CFFF features three bays for coal delivery, offering hot gas flows of 8 and 30 lb/sec, and a third rate for outside contractor studies. A Low Mass Flow test train is intended for engineering tests of component performance, durability, and scaling parameters. An oxygen-rich gas composed of oxygen, nitrogen, and No. 2 fuel oil will be heated to 1283 K for mixing with pulverized coal, a carrier gas, and a seed material such as potassium carbonate and/or potassium sulfate and burned substoichiometrically to produce an ionized gas. The gas flow is routed through a diagnostic channel to determine the MHD output, plasma uniformity, and gas dynamic conditions. Further systems for slag removal, pollution control, magnetic field generation, and data acquisition are detailed. M.S.K.

A82-24690 **Biomass options for the big island of Hawaii.** P. C. Meagher and E. M. Kinderman (SRI International, Menlo Park, CA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 92-98.

Potential sources of renewable energy which can serve to displace some of the 500 million dollars spent each year by Hawaii for petroleum products are examined, particularly for biomass opportunities. Solar heating is noted to have minimal impact due to favorable weather conditions, while hydropower potential is limited and wind use, although very appealing, will be limited to a 10-15% contribution to the total due to aesthetic power quality, and land-use considerations. Geothermal is projected to steadily grow to 500 MW production. Sugar plants burn bagasse to produce power totalling 9 MW, while a growing logging industry offers increased forest residue for power production competitive with diesel fueled generators. Bagasse, cane trash, sweet sorghum, and ocean plants for alcohol and ethanol formation are not economically feasible unless coupled to a geothermal heating method for thermochemical conversion, and offers the only alternative for liquid fuels imports. M.S.K.

A82-24696 **From steam to kilowatts - Planning, siting and regulatory considerations in geothermal resource development.** J. F. McKenzie (Pacific Gas and Electric Co., San Francisco, CA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 166-173.

A82-24803 **Novel metal-ceramics-composite sealing coatings in aircraft engines (Neuartige Metall-Keramik-Verbund-Dichtungsbeläge in Flugtriebwerken).** A. Sickinger and V. Wilms (Motoren- und Turbinen-Union München GmbH, Munich, West Germany). In: Composite materials; Lecture and Discussion Meeting, Constance, West Germany, April 17, 18, 1980, Reports. Oberursel, West Germany, Deutsche Gesellschaft für Metallkunde, 1981, p. 133-140. In German.

Requirements for the enhancement of the performance of aircraft engines and the reduction of fuel consumption make it necessary to operate aircraft engines at higher gas pressures and temperatures. The development of novel metal-ceramics-composite sealing coatings makes it possible to overcome certain problems related to more exacting sealing requirements and greater thermal extension in connection with the new operational conditions. The sealing coating provides a means to compensate for different thermal extensions and manufacturing tolerances existing for rotating and stationary structural components. It is feasible to obtain minimum clearance values and to reduce attrition effects for the rotating component. Other important benefits of the coating are related to its thermal-barrier characteristics. Attention is given to the requirements which the coating has to satisfy, its application by thermal spraying, the coating composition, and some test results. G.R.

A82-25161 **Trade-offs in NO/x/ control.** R. Whitaker. *EPRI Journal*, vol. 7, Jan.-Feb. 1982, p. 18-25.

Mechanisms which produce NO(x) pollutants in coal burning power plants are reviewed, along with methods for lowering the emissions. The pollutant is formed by oxidizing the nitrogen in the combustion air (20-40%) and from burning coal with too lean an air-fuel ratio in initial combustion stages (60-80%). All low-NO(x) furnace designs currently feature staging with, e.g., delayed mixing as the fuel enters or reburning of the gases coming from the furnace. Control adjustments are noted to serve as immediate steps for pollutant reduction in retrofit plants, and tangentially fired boilers have demonstrated NO(x) emissions as low as 0.2 lb/1,000,000 Btu. The selective catalytic reduction process, mentioned as showing the most cost-effective possibilities, is a post-combustion process which achieves a 60-80% reduction in NO(x) flue gas. M.S.K.

A82-25507 **Status and near-term development goal - A solar hydrogen economy.** P. Brennecke, H. H. Ewe, and E. W. Justi

(Braunschweig, Technische Universität, Braunschweig, West Germany). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 52-57. 14 refs.

The possibilities of total conversion to a world hydrogen-based economy is discussed, noting that economically retrievable coal reserves will be depleted by 2033, at which time a 2-4 C rise in the world atmospheric temperature will have resulted. The removal of large coal, nuclear, and windpowered central generating plants to offshore locations, and solar thermal plants to remote, sunny locations, along with large photovoltaic installations, is recommended as a means of ameliorating the nuissances and dangers of building such facilities near populations. The removal of energy-producing centers from populated areas necessitates long-distance energy transmission, which is noted to be achievable by employing hydrogen gas in natural gas-type transmission pipes. The hydrogen could be produced electrolytically, and an effort during the 1980's to found a common hydrogen pipeline between France and Germany is mentioned. M.S.K.

A82-25660 The Solar Power Satellite - An opportunity for Third World development. R. Mayur and P. E. Glaser (SUNSAT Energy Council, Cold Spring, NY). *(United Nations, Conference on New and Renewable Sources of Energy, Nairobi, Kenya, Aug. 10-21, 1981.) Space Solar Power Review*, vol. 2, no. 4, 1981, p. 329-335. 26 refs.

The application of Solar Power Satellite (SPS) systems in conjunction with other renewable energy configurations such as flat plate collectors, windmills, hydroelectric power stations, OTEC, and photovoltaic cells to alleviate the shortages and costs of energy sources in developing nations is recommended. Education of people in the Third World to potential benefits of space resources exploitation is a way to involve them in space activities in the 21st century. SPS systems are noted to have a potential of freeing millions of tons of manure and firewood for other uses. Potential land-use and legal definitions of GEO problems are indicated, along with the potential for ocean-basing the rectennas to serve as mariculture sites. M.S.K.

A82-25665 Assessing the Solar Power Satellite - The OTA experience. R. A. Williamson, S. Weisburd, and A. Wasserman (Office of Technology Assessment, Washington, DC). *Space Solar Power Review*, vol. 2, no. 4, 1981, p. 383-392. 19 refs.

A review of an Office of Technology Assessment examination of SPS potentials and problems as an energy source is presented, along with an examination of the SPS effects on other space systems. The SPS configuration considered included solar cell conversion to klystron transmission to rectennas, with the solid-state converters located on the back of each solar panel. A LEO-based laser system was also explored, along with LEO-based large mirrors to reflect light to selected spots on the earth. A need for the SPS if energy end-use requirements grow to more than 20 quads by the year 2015 was noted, and economic competitiveness with solar technologies and extent of development of the technology was concluded to be on the same level as fusion. Developing the SPS technology was found to offer significant opportunities for advancing U.S. space technology. M.S.K.

A82-25666 Dust removal from small- and medium-sized coal-fired generators (La dépoussiérage des petites et moyennes chaudières à charbon). R. Bouscaren (Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique, Paris, France). *Pollution Atmosphérique*, vol. 23, Oct.-Dec. 1981, p. 299-312. 11 refs. In French.

The problem of dust removal from the emissions of industrial coal-fired generators of capacity less than 50,000 th/h is considered in light of increasing emphasis on coal as an energy source. Following a brief review of dust emission standards and the characteristics of dust emission prior to purification, means for the reduction of dust production in various types of combustors are examined. The advantages and disadvantages of the various available types of removal systems are surveyed, with attention given to mechanical removal, wet removal, porous layer removal, and electrical removal. Economic aspects of the installation and operation of dust removal techniques are then surveyed. It is recommended that pollution standards be temporarily relaxed in order to promote the use of coal in small installations, while intense efforts be undertaken to develop reliable, affordable equipment for dust removal from exhaust emissions. A.L.W.

A82-25669 Ten years of the fight against air pollution in Japan - Evaluation of a policy (Dix années de lutte contre la pollution de l'air au Japon - Bilan d'une politique). P. Jarrault (Institut Français de l'Energie, Paris, France), A. Pradinaud (Agence Financière Rhin-Meuse, France), and R. Guillet. *Pollution Atmosphérique*, vol. 23, Oct.-Dec. 1981, p. 337-352. 6 refs. In French.

Major aspects of the efforts at air pollution control in Japan over the past 10 years are discussed. Pollution control policy in Japan has been characterized by a basis in sentiment rather than economic considerations, an emphasis on certain types of pollution, enforcement by direct administrative surveillance, the use of indemnity payments to victims and the importance of the local authorities. While mean annual SO2 concentrations have declined from 0.06 to 0.04 ppm from 1965 to 1977, nitrogen oxide levels have increased and stabilized at a level of 0.03 ppm and the air quality standards have been revised upwards. Pollution monitoring is accomplished through national and local networks. Detailed emission standards exist for sulfur dioxide and nitrogen oxides and to a lesser extent solid particles and odorous products, and are met by strategies including emission reduction, fuel and emission desulfurization, taxation of emissions, catalytic conversion, and pollution prevention. A.L.W.

A82-26327 Air pollution control technology - An overview. S. R. Orem (Industrial Gas Cleaning Institute, Inc., Alexandria, VA). *Air Pollution Control Association, Journal*, vol. 32, Mar. 1982, p. 246-249.

An overview is presented of the equipment and economics of pollution control devices for industrial applications. Attention is given to the Venturi scrubber, high order pressure drops, mechanical/centrifugal, cyclonic devices, baghouses, the Hersey reverse jet blow ring, electrostatic precipitators, and flue gas desulfurization. A total of over one and 1/3 billion dollars was spent on air pollution control equipment in 1980. The development of cartridge-type filters filled with synthetic fabrics such as fiberglass mesh for baghouses is reviewed, as is the growth of installed electrostatic precipitator units, totalling 42.274 GW of installed capacity in 1980. A steady growth in the total capacity of scrubbers is foreseen with the tendency for the use of coal as a primary energy source. M.S.K.

A82-26368 Progress on alternative energy resources. H. T. Couch (United Technologies Research Center, East Hartford, CT). *Astronautics and Aeronautics*, vol. 20, Mar. 1982, p. 42-47.

Progress in the year 1981 toward the development of energy systems suitable for replacing petroleum products combustion and growing in use to fulfill a near term expansion in energy use is reviewed. Coal is noted to be a potentially heavy pollution source, and the presence of environmentally acceptable methods of use such as fluidized-bed combustion and gasification and liquefaction reached the prototype stage in 1981, MHD power generation was achieved in two U.S. plants, with severe corrosion problems remaining unsolved for the electrodes. Solar flat plate collectors sales amounted to 20 million sq ft in 1981, and solar thermal electric conversion systems with central receivers neared completion. Solar cells are progressing toward DOE goals of $.70/peak W by 1986, while wind energy conversion sales were 2000 machines in 1981, and the industry is regarded as maturing. Finally, geothermal, OTEC, and fusion systems are reviewed. M.S.K.

A82-26407 The Nanticoke shoreline diffusion experiment, June 1978. IV. A - Oxidation of sulphur dioxide in a power plant plume. B - Ambient concentrations and transport of sulphur dioxide, particulate sulphate and nitrate, and ozone. K. G. Anlauf, P. Fellin, H. A. Wiebe (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada), and O. T. Melo (Ontario Hydro, Research Div., Toronto, Canada). *Atmospheric Environment*, vol. 16, no. 3, 1982, p. 455-466. 29 refs.

A82-26409 Modeling continuous fumigation of Nanticoke generating station plume. P. K. Misra (Ontario Ministry of the

Environment, Air Resources Branch, Toronto, Canada) and S. Onlock (Monitec Limited Concord, Ontario, Canada). *Atmospheric Environment*, vol. 16, no. 3, 1982, p. 479-489. 13 refs.

A shoreline fumigation model is verified with the data from two studies conducted for the Ontario Hydro generating station plumes at Nanticoke. The model reproduces the physical system of continuous fumigation reasonably well. Predictions are shown to agree with observed values within the framework of the uncertainties in various input parameters. As expected, the parameters defining the state of the onshore air mass are critical in the estimate of ground level concentrations inside the fumigation zone. Also, sampling time plays an important role, even though data from the averaging of three to four helicopter passes conform to half hourly average concentration data and model predictions very well. (Author)

A82-26568 # Fuel optimal trajectory computation. J. W. Burrows (Boeing Computer Services Co., Energy Technology Applications Div., Seattle, WA). *Journal of Aircraft*, vol. 19, Apr. 1982, p. 324-329. 8 refs.

Roughly a quarter of the total fuel savings of the new generation of large jet transports will come from the capability of computing fuel optimal flight trajectories between departure point and destination. The shape of the trajectory in the vertical plane is treated here. A simplified mathematical model is described including spline fits to the drag and fuel flow functions. A suboptimal trajectory is found using the maximum principle of optimal control and singular perturbation theory. The inner or boundary-layer solutions are identified as the climb or descent segments of the flight, while the outer solution corresponds to cruise. The inner solutions are expanded to second order in the vicinity of the outer solution to develop cruise control laws for cost-effective response to altered in-flight conditions. (Author)

A82-27828 # Legal implications of economic activities in outer space. A. A. Cocca. In: Colloquium on the Law of Outer Space, 24th, Rome, Italy, September 6-12, 1981, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1982, p. 19-23. (IAF 81-SL-50)

The directions of economically-driven activities in space are projected, along with legal guidelines -present or future- which will ensure maximum freedom for space development and restraint in areas of general concern. Policy objectives in economic matters of space exploitation are defined as space resources development for integration in the world economy, open cooperation between nations, a prevention of monopolies, and pricing which is equitable. Celestial body-based resources are noted to be open to exploitation although no claim can be made on undeveloped territories. The formation of space-oriented companies such as Intelsat, Intersputnik, the Space Committee, New World, Inc., Otrag, etc. are mentioned as positive manifestations of business activities operating without legal interference. Further review is given to insurance policies, formation of a Space Bank, and maintaining the Shuttle under NASA control. M.S.K.

A82-27851 # Ecospace. E. R. Finch, Jr. (Finch and Schaefler, Attorneys, New York, NY). In: Colloquium on the Law of Outer Space, 24th, Rome, Italy, September 6-12, 1981, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1982, p. 189-193. (IAF 81-SL-40)

The paper defines Ecospace as the policy basis for 'international regimes' for global resources, including outer space. It discusses some 'Ecospace legal truths': (1) outer space requires long-range policy planning; (2) outer space is inherently international; (3) outer space provides solutions for the global resource shortage problems; (4) outer space is a factor for world peace, information and trade; and (5) participation by as many nations as possible in outer space is desirable. Various outer space treaties are marked as accomplishments. Solar power satellite plans are recommended noting Space Shuttle usages. Finally, four options are presented to the United States: (1) do it alone; (2) do nothing; (3) more R&D; and (4) cooperation with the Soviet Union. C.D.

A82-27853 # International legal basis and organizational framework for space activities - Present state, problems and prospects. V. Kopal (United Nations, Outer Space Affairs Div., New York, NY). In: Colloquium on the Law of Outer Space, 24th, Rome, Italy, September 6-12, 1981, Proceedings. New York, American Institute of Aeronautics and Astronautics, 1982, p. 201-205. 12 refs. (IAF 81-SL-51)

The present legal and organizational framework for international cooperation in space is reviewed with emphasis on the role of the United Nations and, in particular, of the UN Committee on the Peaceful Uses of Outer Space (COPUOS). The discussion covers principal legal instruments governing activities in space and international programs of space exploration and space applications promoted by the United Nations. Some current legal issues under consideration in the COPUOS are examined, including legal implications of remote sensing of the earth from space, the use of artificial satellites for direct television broadcasting, consideration of the possibility of supplementing the norms of international law relevant to the use of nuclear power sources in outer space, definition of outer space, and the legal status of the geostationary orbit. V.L.

A82-28000 Biomass energy systems and the environment. H. M. Braunstein, P. Kanciruk, R. D. Roop, F. E. Sharples, J. S. Tatum, and K. M. Oakes (Oak Ridge National Laboratory, Oak Ridge, TN). New York and Oxford, Pergamon Press, 1981. 190 p. 416 refs. $13.50.

The technology, resources, applied, and experimental features of biomass energy resources are explored, with an emphasis on environmental and social implications of large-scale biomass development. The existing land and water based biomass resource is described in terms of available energy, ecological concerns, agricultural crops, livestock production, freshwater systems, and ocean systems. Attention is given to proposed systems of biomass energy production from forestry and silviculture, agricultural crops, livestock wastes, and freshwater and ocean systems. A survey is made of various biomass materials, techniques for conversion to gas, liquid fuels, or for direct combustion, and impacts of large-scale biomass production and harvest are examined. Particular note is made of the effects of scaling biomass conversion systems, including near- and long-term applications, and ethics and aesthetic concerns. M.S.K.

A82-28523 The impact of mixing cooling tower and power plant plumes on sulfate aerosol formation. J. F. Meagher, E. M. Bailey (Tennessee Valley Authority, Muscle Shoals, AL), and M. Luria (Jerusalem, Hebrew University, Jerusalem, Israel). *Air Pollution Control Association, Journal*, vol. 32, Apr. 1982, p. 389-391. 8 refs. Research supported by the Tennessee Valley Authority; U.S. Environmental Protection Agency Contract No. EPA-IAG-D9-E721-DL.

Results of a study to determine the effect of power plant-cooling tower interaction on sulfate production from a coal-burning power plant are described. The plant investigated had one 244 m and two 183 m stacks, each connected to an electrostatic precipitator. Intermixing of the plumes in the afternoon hours resulted in increased SO2 oxidation. The excess SO4(-2) production is concluded to occur in a water droplet or on the wet surface of a particle, with metal ions such as Fe(+3) and Mn(+2) also playing an as yet undetermined role. The formation enhancement lasts only as long as wetted surfaces and/or increased reactant concentrations are present. M.S.K.

N82-16057# Department of Energy, Washington, D. C.
SYMPOSIUM ON COMMERCIAL AVIATION ENERGY-CONSERVATION STRATEGIES
1981 373 p refs Proceedings of Symp. on Commercial Aviation Energy Conserv. Strategies, Washington, D.C., 2-3 Apr. 1981 Sponsored in part by FAA, Washington, D.C.
(DE81-028406; CONF-8104103) Avail. NTIS HC A16/MF A01

Energy conservation strategies applicable to commercial aviation are presented. General topics discussed include Federal and industry conservation programs such as flight operations, air traffic control, engineering and maintenance, and corporate management strategies. Included is a discussion of possible future actions. DOE

N82-16064*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NASA RESEARCH ACTIVITIES IN AEROPROPULSION
John F. McCarthy, Jr. and Richard J. Weber 1982 30 p refs
Presented at the 24th Ann. Conf. on Aviation and Astronautics, Tel Aviv, Israel, 17-18 Feb. 1982
(NASA-TM-82788; E-1113) Avail: NTIS HC A03/MF A01 CSCL 21E

NASA is responsible for advancing technologies related to air transportation. A sampling of the work at NASA's Lewis Research Center aimed at improved aircraft propulsion systems is described. Particularly stressed are efforts related to reduced noise and fuel consumption of subsonic transports. Generic work in specific disciplines are reviewed including computational analysis, materials, structures, controls, diagnostics, alternative fuels, and high-speed propellers. Prospects for variable cycle engines are also discussed.
Author

N82-16139*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ENERGY CONSUMPTION FOR THE ECHO STATION (DSS 12)
C. N. Guiar and D. Schonfeld *In its* The Telecommun. and Data Acquisition Rept. 15 Dec. 1981 p 355-363 refs

Avail: NTIS HC A16/MF A01 CSCL 10B

Energy consumption for the Echo Station is analyzed. The HVAC equipment including vapor compression refrigeration units, absorption chillers, annd heating units such as boilers and heat pumps is shown to be the largest consumer of electrical energy. The energy consumption for the buildings at the station is itemized and compared to the electrical meter data. The figures for energy consumption as predicted by the ECP computer program are found to agree well with the meter data.
J.D.H.

N82-16259# Bevilacqua (O. M.) and Associates, Oakland, Calif.
ENVIRONMENTAL ASSESSMENT OF THE USE OF ALCOHOL FUELS IN HIGHWAY VEHICLES
O. M. Bevilacqua, M. J. Bernard, III, D. Sperling, S. Rosenberg, L. J. Hill, D. Fingleton (WAPORA, Inc., Chicago), P. DEliscu (Santa Clara Univ.), and J. R. Gasper Dec. 1980 307 p refs
Prepared jointly with Argonne National Lab.
(Contract W-7405-eng-38)
(DE82-000887; ANL/CNSV-14) Avail: NTIS HC A14/MF A01

Impact associated with alcohol fuel storage, distribution, and use are assessed under four possible scenarios of alcohol fuel use during the period 1980 to 2000. Alcohol use is projected to range from 196 million bbl/yr by 2000, up from 5 million barrels in 1980. In addition to effects on the physical environment (aquatic and terrestrial ecosystems, air quality, and energy resources), consideration is given to the impacts of alcohol fuel use on such social and economic concerns as health and safety, employment, retail fuel costs, balance of trade, capital investments, and regulatory needs. Although some potentially negative impacts are identified, in general, the assessment finds that the use of alcohol fuels would have a positive or neutral effect on the environment; moreover, the negative impacts could be mitigated through the judicious application of existing regulatory controls and procedural standards.
DOE

N82-16265# Fulton Energy Corp., Tulsa, Okla.
ASSESSMENT OF THE ECONOMIC, TECHNICAL, AND ENVIRONMENTAL FEASIBILITY OF DEVELOPING, CONSTRUCTING, AND OPERATING A 25-MILLION-GALLON-PER-YEAR GRAIN-ETHANOL-PRODUCTION FACILITY. VOLUME 1: EXECUTIVE SUMMARY
May 1981 47 p 4 Vol.
(Contract DE-FG07-80RA-50365)
(DE82-000294; DOE/RA-50365/T1-Vol-1) Avail: NTIS HC A03/MF A01

The economic, technical, and environmental feasibility of developing, constructing, and operating a 25 million gallon per year ethanol facility in northeastern Oklahoma was determined. The executive summary is presented. A site providing the necessary grain, energy, and labor resources; flexible transportation methods and alternatives for receiving and shipping; nearby markets for products and by-products; an existing environmental quality able to withstand the minor impacts of the process; and a receptive and growing business and community environment was selected. The ability to produce a high quality product at a reasonable and competitive price with or without federal assistance or state assistance in the form of tax exemptions is demonstrated. It is shown that coal burning technologies are efficient, whether conventional burning methods or innovative methods such as fluidized-bed combustion are used. All resources for the process are available nearby. The grains required come from carryover reserves, thus not impacting the food supply. The residual by-products are in high demand.
DOE

N82-16266# Fulton Energy Corp., Tulsa, Okla.
ASSESSMENT OF THE ECONOMIC, TECHNICAL, AND ENVIRONMENTAL FEASIBILITY OF DEVELOPING, CONSTRUCTING, AND OPERATING A 25-MILLION-GALLON-PER-YEAR GRAIN-ETHANOL-PRODUCTION FACILITY. VOLUME 2: TECHNICAL ANALYSIS
May 1981 178 p 4 Vol.
(Contract DE-FG07-80RA-50365)
(DE82-000479; DOE/RA-50365/T1-Vol-2) Avail: NTIS HC A09/MF A01

The technical analysis of a study to determine the economic technical, and environmental feasibility of developing, constructing, and operating a 25 million-gallon per year ethanol facility in northeastern Oklahoma is presented. It is shown that coal burning technologies are efficient, whether conventional burning methods or innovative methods such a fluidized-bed combustion are used. All resources for the process are available nearby. The grains required come from carryover reserves, thus not impacting the food supply. The residual by-products are in high demand.
DOE

N82-16359# Bharat Heavy Electricals Ltd., Bhopal (India).
SEMINAR: ENERGY CONSERVATION. ROLE OF POWER CAPACITORS: CONCEPTS AND POLICY ISSUES
R. K. Pachauri 6 Aug. 1981 44 p refs
(PB81-247967) Avail: NTIS HC A03/MF A01 CSCL 09C

Energy conservation and power capacitors concepts and policy issues energy conservation by application of power capacitors in Indian power system network, the application of dynamic shunt compensation, and the application of series capacitors in distribution circuits are discussed.
Author

N82-16417# Department of Energy, Bartlesville, Okla. Energy Technology Center.
PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES, THIRD SERIES, 1978 BUICK 196 CID (3.2L), 2V Interim Report, Jun. 1981
D. E. Koehler, W. F. Marshall, and K. R. Stamper Jun. 1981 57 p
(Contract DOT/TSC-RA-77-07)
(PB81-236630; BETC/OP-81/52; DOT-TSC-NHTSA-81-7; DOT-HS-805813; Rept-14) Avail: NTIS HC A04/MF A01 CSCL 21G

The 1978 Buick 196 CID engine was dynamometrically tested to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady state engine operating modes. The objective is to obtain engine performance data to estimating emissions and fuel economy for varied engine service and duty. The intent is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.
GRA

N82-16449# Colorado Energy Research Inst., Golden.
OIL SHALE 1982: A TECHNOLOGY AND POLICY PRIMER
Nov. 1981 92 p refs Prepared in cooperation with Colorado School of Mines, Golden
Avail: NTIS HC A05/MF A01

An updated policy primer and technology assessment of the oil shale industry is presented for the benefit of policy makers and the general public. Methods for the development, management, and use of energy are discussed. The biological, economic, social, and political impacts and controversies surrounding current and future energy related activities are considered. Mining methods, retort processing, and methods for disposing of the shale are also discussed.
M.D.K.

N82-16488# Brookhaven National Lab., Upton, N. Y. Process Sciences Div.
CARBON DIOXIDE POWER PLANT FOR TOTAL EMISSION CONTROL AND ENHANCED OIL RECOVERY
Frederick L. Horn and Meyer Steinberg Aug. 1981 28 p refs
(Contract DE-AC02-76CH-00016)

(DE81-030734; BNL-30046) Avail: NTIS HC A03/MF A01

The design of a compact environmentally acceptable carbon dioxide diluted coal-oxygen fired power plant is described. The plant releases no combustion products to the atmosphere. The oxygen for combustion is separated in an air liquefaction plant and the effluent nitrogen is available for use in oil well production. Recycle carbon dioxide mixed with oxygen replaces the nitrogen for the combustion of coal in the burners. The carbon dioxide produced is used in enhanced oil recovery operations and injected into spent wells and excavated salt cavities for long-term storage. The recovery of CO2 from a coal-burning power plant by this method appears to have the lowest energy expenditure and the lowest by-product cost compared to alternative removal and recovery processes. DOE

N82-16461# Federal Energy Regulatory Commission, Washington, D. C.

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: JORDAN RIVER BASIN, UTAH

Aug. 1981 75 p refs

(DE82-000416; FERC-0084) Avail: NTIS HC A04/MF A01

The water resources of the Jordan River Basin which covers approximately 3450 sq.mi. in north central Utah are evaluated. Data are presented on existing and potential water resource development, on water use by existing and proposed steam-electric generating plants, and on the status of hydroelectric power plant licensing. Past and current planning studies are summarized. DOE

N82-16467# Department of Agriculture, Washington, D.C. Natural Resource Economics Div.

IMPLICATIONS OF LAND, WATER AND ENERGY RESOURCE POLICIES ON AGRICULTURAL PRODUCTION

Klaus Alt, Norman Landgren, Richard Clark, Veral Benson, and William Anderson May 1981 96 p refs

(PB81-244063; AGESS-810513) Avail: NTIS HC A05/MF A01 CSCL 02A

The nature and potential impact of several natural resource and environmental policies on the use of land and water in agricultural production are discussed. The land control policies considered are those which may cause the owners to change land use to reduce soil erosion, to decrease wetland drainage and to preserve prime farmland in agriculture. Water policies are considered which related to the preservation of minimum in stream water flows, increasing the efficiency of irrigation, and meeting competition for water from energy production. DOE

N82-16494*# IIT Research Inst., Chicago, Ill.

INTERNATIONAL MARKET ASSESSMENT OF STAND-ALONE PHOTOVOLTAIC POWER SYSTEMS FOR COTTAGE INDUSTRY APPLICATIONS Final Report

Therese M. Philippi Nov. 1981 290 p refs

(Contracts DEN3-197; DE-AI01-79ET-20485)

(NASA-CR-165287; DOE/NASA/0197-1; IITRI-J06519) Avail: NTIS HC A13/MF A01 CSCL 10B

The final result of an international assessment of the market for stand-alone photovoltaic systems in cottage industry applications is reported. Nonindustrialized countries without centrally planned economies were considered. Cottage industries were defined as small rural manufacturers, employing less than 50 people, producing consumer and simple products. The data to support this analysis were obtained from secondary and expert sources in the U.S. and in-country field investigations of the Philippines and Mexico. The near-term market for photovoltaics for rural cottage industry applications appears to be limited to demonstration projects and pilot programs, based on an in-depth study of the nature of cottage industry, its role in the rural economy, the electric energy requirements of cottage industry, and a financial analysis of stand-alone photovoltaic systems as compared to their most viable competitor, diesel driven generators. Photovoltaics are shown to be a better long-term option only for very low power requirements. Some of these uses would include clay mixers, grinders, centrifuges, lathes, power saws and lighting of a workshop. Author

N82-16496# Technische Hogeschool, Delft (Netherlands). Dept. of Urban and Regional Planning.

WIND ENERGY PLANNING CONSIDERATIONS [WINDENERGIE IN PLANOGISCH PERSPEKTIEF]

A. vanSetten and H. Voogd Apr. 1980 19 p refs In DUTCH Presented at Planning Conf., Amsterdam, Apr. 1980

(PM-80-4) Avail: NTIS HC A02/MF A01

Windpowered utilization in the Netherlands and the search for wind rich areas is discussed. It is suggested that large water areas, like the North Sea and Market Lake, are the preferred areas for wind powered energy production. Storage of wind energy in large water basins is suggested. Government wind energy production programs like the installation of wind parks, and difficulties because of opposing local interests are discussed. Windmill exploration by small private industry, rather than by government administered programs, are outlined. E.A.K.

N82-16504# Oak Ridge National Lab., Tenn.

ENERGY IN THE 1980S: A CALL FOR LEADERSHIP. THE PUBLIC AWARENESS SYMPOSIUM

Jul. 1981 79 p refs Presented at WATTec Energy Awareness Conf., Knoxville, Tenn., 18-20 Feb. 1981

(Contract W-7405-eng-26)

(DE81-027613; CONF-810250) Avail: NTIS HC A05/MF A01

A variety of programs was offered. Issues relevant to US energy problems were addressed. The energy-related wares of 43 leading domestic and foreign industrial and commercial institutions were displayed. The public awareness symposium included business, government, religious, and educational leaders. The technical societies' presidents' program brought together 25 national presidents or their representatives to discuss mutual concerns. Finally, two $1000 engineering and communication scholarships were awarded for creating new and novel ways of providing the general public with information on complex energy-related technical matters. DOE

N82-16507# Oak Ridge National Lab., Tenn. Health and Safety Research Div.

RISK OF PRODUCING ENERGY, AND CONSERVING IT

H. Inhaber, G. Caton, and R. Gove 1981 25 p refs Presented at 6th Intern. Symp. on the Uranium Inst., London, Sep. 1981

(Contract W-7405-eng-26)

(DE81-030807; CONF-810965-1) Avail: NTIS HC A02/MF A01

The idea that society can have a free lunch in the form of a risk-free energy system is rapidly fading away. All energy systems have some risk to human health, and for some it can be substantial. Nuclear power seems to have both a low occupational and public risk compared to other forms. In addition to this, research is presented with calculations on some of the risk associated with sealing up houses to keep heat in. When the effects of the accumulated radon are included; the risk per unit energy saved for this form of conservation can be great. Indeed, it appears to be much greater than the public risk of nuclear power. DOE

N82-16510# Department of Energy, Washington, D. C. Assistant Secretary for International Affairs.

ENERGY INDUSTRIES ABROAD

Sep. 1981 299 p refs

(DE82-001896; DOE/IA-0012) Avail: NTIS HC A13/MF A01

The relationships between foreign governments and energy industries in many of the world's most important energy producing and consuming nations are examined. The history of hydrocarbon exploration and production is traced and the concessionary and other contractual arrangements entered into by foreign governments and international oil companies are reviewed. Petroleum legislation that was enacted, how government institutions gradually assumed more responsibility for energy matters, and how the former concessionaires adapted to accommodate this increased government participation in the energy sector is described. DOE

N82-16513# Arizona Univ., Tucson. Engineering Experiment Station.

CHOICE AND UTILIZATION OF ENERGY-USING DURABLES

Electric Power Research Inst. Aug. 1981 349 p refs Workshop held in Boston, 1-2 Nov. 1979 Sponsored by Electric Power Research Inst.

(EPRI Proj. 1050)

(DE81-904228; EPRI-EA-1981; CONF-7911154) Avail: NTIS HC A15/MF A01

The adequacy of state of the art methods to analyze the choice and utilization of energy using durables by households is assessed. The long run adjustment process of households to higher energy prices is characterized in large part by their choice of type and efficiency of new energy using durables (e.g., major appliances and automobiles). Trade-offs must be made between original purchase price and future operating costs, the latter depending not only on prospective energy costs but on expected levels of utilization. Considerable progress has been made in modeling these important factors and their interactions. DOE

N82-16514# Pacific Northwest Lab., Richland, Wash.
ANALYSIS TO DEVELOP A PROGRAM FOR ENERGY-INTEGRATED FARM SYSTEMS
D. E. Eakin, M. A. Clark, L. K. Inaba, and K. I. Johnson Sep. 1981 127 p refs
(Contract DE-AC06-76RL-01830)
(DE82-000318; PNL-3981) Avail: NTIS HC A07/MF A01

A program to use renewable energy resources and possibly develop decentralization of energy systems for agriculture is discussed. The program's objective is determined by: (1) an analysis of the technologies that could be utilized to transform renewable farm resources to energy by the year 2000, (2) the quantity of renewable farm resources that are available, and (3) current energy-use patterns. Individual research, development, and demonstration projects are fit into a national program of energy-integrated farm systems on the basis of market need, conversion potential, technological opportunities, and acceptability. Quantification of these factors for the purpose of establishing program guidelines is conducted using the following four precepts: (1) market need is identified by current use of energy for agricultural production; (2) conversion potential is determined by the availability of renewable resources; and (3) technological opportunities are determined by the state-of-the-art methods, techniques, and processes that can convert renewable resources into farm energy. DOE

N82-16516# Oak Ridge National Lab., Tenn. Engineering Technology Div.
ASSESSMENT OF SEASONAL-EFFICIENCY MODELS FOR NATURAL-GAS FIRED RESIDENTIAL FURNACES
N. Domingo and E. G. Keshock Sep. 1981 81 p refs
(DE82-000499; ORNL-5801) Avail: NTIS HC A05/MF A01

Several methods for determining the seasonal efficiency and operating costs of residential fossil-fuel-fired heating systems are discussed. Four computer models for determining such efficiency, the Honeywell HFLAME model, the National Bureau of Standards DEPAF model, the Institute of Gas Technology SPACE-FI model, and the Carrier Corporation model, are separately described, discussed, and evaluated in relation to their use in predicting seasonal performance of residential gas-fired heating systems. A general conclusion is that purely analytical estimations of seasonal furnace efficiencies are not generally reliable principally because of: (1) a variety of furnace designs; and (2) the different infiltration characteristics of homes. DOE

N82-16523# Argonne National Lab., Ill. Energy and Environment Systems Div.
ANALYSIS OF STATE-ENERGY-PROGRAM CAPABILITIES
John Tatar, Donald Clifford, Forrest Gunnison (Science Applications, Inc.), and Barbara Humphrey May 1981 62 p refs
(Contract W-31-109-eng-38)
(DE82-001963; ANL/CNSV-TM-82) Avail: NTIS HC A04/MF A01

The potential effects on state energy programs of a reduction in the financial assistance available through the state and local assistance programs and the distribution of those effects are assessed. The assessment is based on a survey of nine state energy offices (SEOs), which were selected on the basis of state support of energy programs weighted by state energy consumption. The nine SEOs surveyed were the Arizona Energy Office, Arkansas Department of Energy, California Energy Commission, Florida Governor's Energy Office, Illinois Institute of Natural Resources, Minnesota Energy Agency, New Jersey Department of Energy, South Carolina Governor's Division of Energy Resources, and Washington State Energy Office. T.M.

N82-16537# Alabama Energy Management Board, Montgomery.
OPELIKA RESOURCE RECOVERY PROJECT: REPORT ON THE TECHNOLOGICAL AND ECONOMIC EVALUATION
Jul. 1981 127 p refs
(Contract DE-FG01-79C3-20243)
(DE81-030098; DOE/CS-20243/1) Avail: NTIS HC A07/MF A01

A resource recovery facility for the city of Opelika, Alabama was investigated and surrounding areas were examined for waste stream characteristics. Technological options for waste disposal were examined. The technological options were ranked according to specific criteria of market characteristics, compatibility, and commercial viability. A particular resource recovery system applicable to Opelika was identified and an economic analysis performed to compare its relative costs to that of landfilling. DOE

N82-16546# Groupe Centrale des Villes Nouvelles, Paris (France).
A COMPARISON OF ENERGY TECHNOLOGIES AND THEIR USE IN URBAN PLANNING
Claud Martinand and Eric Pebeyrotte Oct. 1980 21 p Presented at the 4th Ann. Conf. of the Intern. New Towns Assoc., Cairo, 6-14 Oct. 1980
(PB81-239592) Avail: NTIS HC A02/MF A01 CSCL 10A

A view of the new energy sources used in construction of new towns in France is given. The energies discussed include solar, geothermal, wind, refuse incineration, and cogeneration; the energy technologies outlined include heat pumps and load shedding. GRA

N82-16549# Little (Arthur D.), Inc., Cambridge, Mass.
NEW YORK STATE PLAN TO ENCOURAGE COMMERCIALIZATION OF MORE EFFICIENT GAS TECHNOLOGIES
Aug. 1981 189 p refs Sponsored by New York State Energy Research and Development Authority and New York Gas Group
(PB81-249997; NYSERDA-81-15) Avail: NTIS HC A09/MF A01 CSCL 10A

The results of a study to determine what field testing demonstration projects would be required to encourage commercialization of more efficient gas technologies and appliances in New York State are given as well as the elements of a plan to carry out the tests and demonstrations. The present status of over 50 energy-saving gas technologies applicable to space conditioning, water heating, and cooking is examined. Three of the most promising technologies for commercialization were found to be: condensing furnaces and boilers; waste heat recovery; and fuel cells. GRA

N82-16550# General Accounting Office, Washington, D. C.
RESIDENTIAL ENERGY CONSERVATION OUTREACH ACTIVITIES: A NEW FEDERAL APPROACH
11 Feb. 1981 40 p refs
(PB81-242349; EMD-81-8) Avail: NTIS HC A03/MF A01 CSCL 10A

An evaluation of the Department of Energy's residential energy conservation outreach activities is presented. The contribution that outreach can make in achieving energy conservation is examined. The effectiveness of alternative techniques and DOE's current program and management are also examined. GRA

N82-16559# Argonne National Lab., Ill. Integrated Assessments and Policy Evaluation Group.
FLUE-GAS DESULFURIZATION: REVIEW OF SELECTED COMMERCIAL AND ADVANCED TECHNOLOGIES
Jerry L. Gillette and Shen-Yann Chiu Feb. 1981 187 p refs
(Contract W-31-109-eng-38)
(DE82-001960; ANL/FE-81-51) Avail: NTIS HC A09/MF A01

Selected technologies for the desulfurization of flue gas are reviewed and evaluated. One of the technologies, wet scrubbing of the gas with a slurry containing either lime or limestone, has attained widespread commercial usage and for this reason is presented as the base case against which 10 second-generation systems of flue-gas desulfurization (FGD) are compared. The new technology include chemical-treatment, or scrubbing, processes and processes that combine scrubbing and filtering of the flue gas. The two combination processes use baghouse filters, with the SO2-collecting material either injected dry or sprayed into the system. The eight straight-scrubbing processes use either wet or dry collecting materials and are identified as follows: aqueous-carbonate, copper-oxide, Bergbau-Forschung, sodium-sulfite-based double-alkali, DOA double-alkali, Chiyoda-121, magnesia, and Wellman-Lord. DOE

N82-16562# Department of Energy, Morgantown, W. Va.
ADVANCED ENVIRONMENTAL CONTROL TECHNOLOGY PROGRAM
Aug. 1981 32 p refs
(DE82-000898; DOE/METC/SP-187) Avail: NTIS
HC A03/MF A01

The Department of Energy has established the Advanced Environmental Control Technology Program to protect the environment while supporting the development of more efficient and acceptable technologies utilizing domestic fossil fuels. This program consolidates cleanup efforts in ongoing technology specific DOE programs (such as combustion and gasification, and cleanup projects transferred from EPA to DOE) with new project initiates into a coordinated program that addresses cleanup technology development. There are numerous problems associated with using coal to replace oil and gas as a primary fuel. Sulfur, nitrogen, alkali and halogen compounds, and mineral particulate matter, all found in varying proportions in the domestic coals, are released during gasification and combustion. These contaminants of coal, as well as the soot and tars produced by incomplete combustion or gasification, can potentially degrade the performance of the energy producing system. DOE

N82-16563# Pacific Northwest Lab., Richland, Wash.
ASSESSMENT OF ENVIRONMENTAL HEALTH AND SAFETY ISSUES ASSOCIATED WITH THE COMMERCIALIZATION OF UNCONVENTIONAL GAS RECOVERY: DEVONIAN SHALE
Sep. 1981 88 p refs
(Contract DE-AC06-76RL-01830)
(DE82-001047; PNL-3848) Avail: NTIS HC A05/MF A01

Potential public health and safety issues and the potential environmental impacts from recovery of natural gas from Devonian age shale are identified. The resource and the DOE eastern gas shales project are described. The new and developing recovery technologies associated with Devonian shale are described. An assessment of the environment, health and safety impacts associated with a typical field is presented. The typical field for this assessment occupies ten square miles and is developed on a 40-acre spacing (that is, there is a well in each 40-acre grid). This field thus has a total of 160 wells. Finally, conclusions and recommendations are presented. A reference list is provided to give a greater plant. Based on the estimated plant cost and the various cases of operating income, an economic analysis was performed employing a profitability index criterion of discounted cash flow to determine an interest rate of return on the plant investment. DOE

N82-16565# Urban Systems Research and Engineering, Inc., Cambridge, Mass.
ENERGY AND ENVIRONMENTAL QUALITY: CASE HISTORIES OF IMPACT MANAGEMENT
Jun. 1981 117 p
(Contract DE-AC01-79EV-10012)
(DE81-028435; DOE/EP-10012/1) Avail: NTIS
HC A06/MF A01

A discussion of energy source developments and environmental protection dealing with impacts, and legal aspects of pollution controls and resource management, and case history studies of major energy projects is presented. DOE

N82-16566# Argonne National Lab., Ill. Integrated Assessments and Policy Evaluation Group.
PUBLIC HEALTH HAZARDS OF LURGI/FISCHER TROPSCH COAL LIQUEFACTION
J. R. Gasper and S. E. Rosenberg Jan. 1981 63 p refs
(Contract W-31-109-eng-38)
(DE82-001617; ANL-EES-TM-153) Avail: NTIS
HC A04/MF A01

The public hazards of wastes from Lurgi/Fischer-Tropsch coal liquefaction were identified. Data on dose response and synergism are not available for many of the waste chemicals from this process. This approach employs two measures of hazards: (1) body burdens that result from exposure to Lurgi/Fischer-Tropsch wastes are compared to body burdens from other sources of the same chemicals; (2) ambient concentrations of pollutants from Lurgi/Fischer-Tropsch operations are projected and compared to various air and water quality standards. DOE

N82-16568# Idaho Univ., Moscow. Dept. of Chemistry.
SULFUR GAS EMISSIONS FROM STORED FLUE GAS DESULFURIZATION SOLIDS Final Report
D. F. Adams Oct. 1981 87 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 856-2)
(DE82-900859; EPRI-EA-2067) Avail: NTIS
HC A05/MF A01

The emissions of volatile, sulfur-containing compounds from the surfaces of 13 flue gas desulfurization (FGD) solids field storage sites were characterized. The sulfur gas emissions from these storage surfaces were determined by measuring the sulfur gas enhancement of sulfur-free sweep air passing through a dynamic emission flux chamber placed over selected sampling areas. Samples of the enclosure sweep air were cryogenically concentrated in surface-deactivated Pyrex U traps. Analyses were conducted by wall-coated, open-tubular, capillary column, cryogenic, temperature-programmed gas chromatography using a sulfur-selective flame photometric detector. Several major variables associated with FGD sludge production processes were examined in relation to the measured range and variations in sulfur fluxes including: the sulfur dioxide scrubbing reagent used, sludge sulfite oxidation, unfixed or stabilized (fixed) RGD solids, and ponding or landfill storage. The composition and concentration of the measured sulfur gas emissions were found to vary with the type of solids, the effectiveness of rainwater drainage from the landfill surface, the method of impoundment, and the sulfate/sulfite ratio of the solids. DOE

N82-16586# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch.
EXHAUST EMISSIONS FROM HIGH-MILEAGE CATALYST-EQUIPPED PASSENGER CARS
Gary T. Jones Jul. 1981 15 p refs
(PB82-103326; EPA-AA-TEB-81-20) Avail: NTIS
HC A02/MF A01 CSCL 13B

Vehicles from the 1975 through 1981 model years were used to examine the effect of 'high mileage' on levels of exhaust emissions. The emission levels from the vehicles involved were examined from four basic views: (1) 'as received' results of the top 15% (by odometer) versus similar results from the bottom 15% and 85%; (2) 'as received' results of vehicles with over 50,000 miles versus those with under 50,000; (3) the effects of restorative maintenance on high mileage vehicles; and (4) the effects of catalyst replacement on high mileage vehicles. The results show that the high mileage vehicles exhibit higher average HC and CO emissions than the lower mileage vehicles. It was also found that on the averge, catalytic converters remain active beyond a vehicle's statutory 'useful life' of 50,000 miles and that restorative maintenance is an effective method to reduce average emission levels. GRA

N82-16595# Environmental Protection Agency, Ann Arbor, Mich. Emission Control Technology Div.
FUEL ECONOMY AND EXHAUST EMISSIONS OF A METHANOL-FUEL CHEVETTE
H. Anthony Ashby May 1981 7 p refs
(PB82-101783; EPA-AA-TEB-81-23) Avail: NTIS
HC A02/MF A01 CSCL 13F

The results of a series of tests conducted over a period of several months on a 1979 Chevrolet Chevette powered by anhydrous methanol are presented. Baseline tests with gasoline were also conducted about three months before the methanol test series began. The exhaust emissions from this car were greatly affected by air-fuel ratio and state of tune. Driveability was not good during most tests when CO met Federal standards. The best optimized adjustments gave a 10 percent better energy efficiency on pure methanol than on gasoline with approximately similar exhaust emission levels. GRA

N82-16607# Environmental Protection Agency, Dallas, Tex.
WASTEWATER TREATMENT FACILITIES, TWINING WATER AND SANITATION DISTRICT, TAOS COUNTY, NEW MEXICO Draft Environmental Impact Statement
Aug. 1981 284 p refs
(PB82-104670; EPA-906/9-81-002) Avail: NTIS
HC A13/MF A01 CSCL 13B

The Twining Water and Sanitation District has considered alternatives for wastewater management which would solve a pollution problem in the high-quality Rio Hondo watershed of northern New Mexico. The district proposes construction of a new advanced treatment plant with a capacity of 95,000 gallons per day. A major alternative is to rehabilitate the existing plant

and provide only the capacity needed to treat existing wastewater flows (83,000 gallons per day). EPA is considering approval and funding of either alternative (as well as providing no funding). Many complex issues bear on EPA's decision, including impacts on water quality, water supply, and socio-economic conditions.
GRA

N82-16610# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Chemical and Biochemical Engineering.
OIL SLICK DISPERSAL MECHANICS Final Report
Chukwuka A. Osamor and Robert C. Ahlert Sep. 1981 238 p refs
(Grant EPA-R-805901)
(PB82-105560; EPA-600/2-81-199) Avail: NTIS HC A11/MF A01 CSCL 13B

The spreading and dissolution behavior of small oil slicks formed from spills of 12 oils was investigated. The increases in area covered by the oils during spreading experiments were determined using photographic techniques. The rate of dissolution of the oils in tap water at 25 C were investigated by equilibrating oils with water in open static tests. Limits of solubilities were established for the oils from equilibration in closed vessels. Six oils were also equilibrated with salt water. A segmented mathematical model were derived and used to correlate experimental data. The primary mechanisms are quantified by analogy to homogeneous and heterogeneous catalysis and detergency. Parameters investigated include oil and dispersant types, oil to dispersant ratios, degree of agitation, and the effect of salt water.
GRA

N82-16614# Bureau of Mines, Salt Lake City, Utah.
HYDROGEN SULFIDE GENERATION BY REACTION OF NATURAL GAS, SULFUR AND STEAM Report of Investigations, Jul. 1981
S. R. Crane, Laird Crocker, and W. I. Nissen Jul. 1981 61 p refs
(PB82-106998; BM-RI-8539) Avail: NTIS HC A04/MF A01 CSCL 13B

A regenerable flue gas desulfurization process was developed. The citrate process uses a buffered weak acid solution to absorb SO2 from the waste gas. The absorbed SO2 is reacted with H2S to precipitate elemental sulfur and regenerate the solution for recycle. The H2S feedstock xor the process may be produced by reacting two-thirds of the recovered elemental sulfur with natural gas and steam. Laboratory investigations and pilot plant operations were conducted by the Bureau to determine if H2S from the natural gas, sulfur, and steam reaction was suitable for the citrate process. The laboratory investigations, in which an H2S generator was integrated with other citrate process operations, provided a basis for design and operation of the pilot plant. The objective was to provide H2S for citrate process pilot plant.
GRA

N82-16618# Versar, Inc., Springfield, Va.
ENVIRONMENTAL ASSESSMENT, SOURCE TEST AND EVALUATION REPORT: COAL PREPARATION PLANT NO. 2 Final Report, Sep. 1979 - Mar. 1981
J. Buroff, J. Strauss, A. Jung, and L. McGilvray Apr. 1981 304 p refs
(Contract EPA-68-02-3136)
(PB82-103573; EPA-600/7-81-071B) Avail: NTIS HC A14/MF A01 CSCL 06F

Results and conclusions are given of a source test and evaluation program at a coal preparation plant, representing cleaning plants that process run of mine coal with high pyritic sulfur content, use high technology coal cleaning processes, operate in a high rainfall environment, and have a low soil neutralization potential. The major objective of the program was to perform an environmental assessment on the plant's waste streams and fugitive emissions. Chemical analysis results indicated that all streams, except fugitive particulates, contained constituents which may have a potentially harmful health and/or ecological effect. For streams showing potential for ecological affects, Mn was of concern for streams showing a potentially harmful health effect. Mn and Or were of prime concern. Contrary to previous studies, high Ni-13 concentrations were observed in the leachate. Further investigation of the Ni-13 source is warranted. Bioassays for fugitive particulates, sedimentation pond waters, and fine refuse slurry solid samples indicated moderate biological effects.
GRA

N82-16767# Control Data Corp., Rockville, Md.
QUSER USER'S GUIDE
Mark D. Buck Sep. 1981 77 p refs
(Contract DE-AC01-80EI-11975)
(DE81-030681; DOE/EIA-11975/T1) Avail: NTIS HC A05/MF A01

The QUSER program functions as the controlling routine of the Midterm Energy Market Model (MEMM). In MEMM, a linear program (LP) is solved iteratively until QUSER determines that all convergence criteria have been met. After each iteration, QUSER is called to calculate new input prices and demands for the next iteration of the LP. The LP solution is considered to be a converged solution when the prices and demands input to the last iteration and the prices and demands from the LP solution differ by less than two percent. QUSER's other main function is to model energy pricing regulations for natural gas and electricity. These policies are based on average prices while the LP solution gives marginal prices. The program uses FORTRAN language.
DOE

N82-16845# Battelle Pacific Northwest Labs., Richland, Wash.
NUCLEAR WASTE MANAGEMENT Quarterly Progress Report, Apr. - Jun. 1981
T. D. Chikalla and J. A. Powell Sep. 1981 136 p refs
(Contract DE-AC06-76RL-01830)
(DE82-001605; PNL-3000-10) Avail: NTIS HC A07/MF A01

Reports and summaries are presented for the following: high-level waste process development; alternative waste forms; TMI zeolite vitrification demonstration program; nuclear waste materials characterization center; TRU waste immobilization; TRU waste decontamination; krypton implantation; thermal outgassing; iodine-129 fixation; NWVP off-gas analysis; monitoring and physical characterization of unsaturated zone transport; well-logging instrumentation development; verification instrument development; mobility of organic complexes of radionuclides in soils; handbook of methods to decrease the generation of low-level waste; waste management system studies; waste management safety studies; assessment of effectiveness of geologic isolation systems; waste/rock interactions technology program; high-level waste form preparation; development of backfill materials; development of structural engineered barriers; disposal charge analysis; and analysis of spent fuel policy implementation. DOE

N82-16846# Piedmont Engineers, Greenville, S.C.
NUCLEAR ENERGY CENTER CONCEPTUAL STUDY, PHASE 3: SITE SPECIFIC EVALUATION - ENVIRONMENTAL RECREATION USE AND PHYSICAL CHARACTERISTICS OF LAKE HARTWELL
Jan. 1981 265 p refs
(Contract DE-AS05-78CR-06074)
(DE81-027337; DOE/OR-06074/1-Vol-3) Avail: NTIS HC A12/MF A01

Socio-economic factors related to the proposed siting of a 15000 MW, twelve-unit nuclear energy center in Anderson County, South Carolina, are presented. Topics included recreational use of Lake Hartwell, terrestrial and aquatic ecology, and atmospheric studies.
DOE

N82-16935# Battelle Pacific Northwest Labs., Richland, Wash.
ANALYSIS OF FEDERAL INCENTIVES USED TO STIMULATE ENERGY CONSUMPTION
R. J. Cole, B. W. Cone, J. C. Emery, M. Huelshoff, D. E. Lanerz, A. Marcus, F. A. Morris, W. J. Sheppard, and P. Sommers Aug. 1981 268 p refs
(Contract DE-AC06-76RL-01830)
(DE81-031928; PNL-3558) Avail: NTIS HC A12/MF A01

Federal incentives that have increased the consumption of coal, oil, natural gas and electricity are identified. The stimulus comes through changing values of variables included in energy demand functions, thereby inducing energy consumers to move along the function in the direction of greater quantity of energy demanded, or through inducing a shift of the function to a position where more energy will be demanded at a given price. The demand variables fall into one of six categories: price of the energy form, price of complements, price of substitutes, preferences, income, and technology. The government can provide such incentives using six different policy instruments: taxation, disbursements, requirements, nontraditional services, traditional services, and market activity. The four major energy forms were examined. Six energy consuming sectors were examined:

residential, commercial, industrial, agricultural, transportation, and public. DOE

N82-16942# San Bernardino Valley Municipal Water District, Calif.
FEASIBILITY OF GEOTHERMAL HEAT USE IN THE SAN BERNARDINO MUNICIPAL WASTEWATER TREATMENT PLANT Final Report, Sep. 1980 - Jun. 1981
W. C. Racine, T. C. Larson, C. A. Stewart, and H. B. Wessel 1981 115 p refs Prepared in cooperation with Science Applications, Inc., La Jolla, Calif., and Stewart (Coulter) and Associates, Inc., Davis, Calif.
(Contract DE-FG03-80SF-11442)
(DE81-030968; DOE/SF-11442/T2) Avail: NTIS
HC A06/MF A01

A system was developed for utilizing nearby low temperature geothermal energy to heat two high rate primary anaerobic digesters. The geothermal fluid would replace the methane currently burned to fuel the digesters. The design and operation of the facility are examined and potentially viable applications selected for additional study. Results of these investigations and system descriptions and equipment specifications for utilizing geothermal energy in the selected processes are presented. The economic analyses conducted on the six engineering design cases are discussed. The environmental setting of the project and an analysis of the environmental impacts that will result from construction and operation of the geothermal heating system are discussed. DOE

N82-16943# Oak Ridge National Lab., Tenn.
ELECTRIC CAR: IS IT STILL THE VEHICLE OF THE FUTURE
R. L. Graves, C. D. West, and E. C. Fox Aug. 1981 29 p refs
(Contract W-7405-eng-26)
(DE81-030437; ORNL/TM-7904) Avail: NTIS
HC A03/MF A01

An analysis of electric and internal combustion engine (ICE) cars of equivalent performance shows that, even with advanced batteries, the electric vehicle would be much more costly to run (23 cents/mile vs 16 cents/mile) than the ICE car. The electric vehicle, of course, would not use gasoline, thus reducing the nation's dependence on imported oil; however, the cost of oil saved in this way would be about $190/bbl, and the same result could be achieved at about one quarter the cost by manufacturing synfuels from domestic coal or oil shale. A similar analysis of some proposed hybrid electric vehicles indicates that they are also more costly to operate than an equivalent conventional vehicle, although by a smaller margin. The cost of oil saved by the use of hybrid vehicles is also lower, although it is still much more than the projected cost of synthetic fuels. The key to improving the economics of the electric vehicle is to increase battery life or lower battery costs. DOE

N82-16946# McElroy (Ralph) Co., Austin, Tex.
TRANSPORT AND ENERGY
Arturo Abriani Sep. 1981 17 p Transl. into ENGLISH from the Symp. on Evaluation and Reinforcement of Pavements and Energy in Transportation (Argentina), 1980 p 103-109 Symp. held in San Miguel de Tucuman, Argentina, 4-6 Sep. 1980; sponsored by the Argentine Congresses of Highway Administration and Traffic Prepared jointly with Argonne National Lab.
(DE81-030287; ANL-Trans-1198) Avail: NTIS
HC A02/MF A01

Energy sources used and the growth of energy consumption in the transportation sector in Argentina are discussed. Energy consumption by the transportation sector in some other major countries of the world are briefly noted. Optimizing transportation energy consumption by means of energy conservation is mentioned. Comparisons are made of energy consumed by rail and road vehicles in urban and interurban areas for freight and passenger transport. DOE

N82-16947# South Coast Technology, Inc., Dearborn, Mich.
AUGMENTATION OF RESEARCH AND ANALYSIS CAPABILITIES FOR TIMELY SUPPORT OF AUTOMOTIVE FUEL ECONOMY ACTIVITIES Final Report, Oct. 1977 - Jan. 1978
Harold M. Siegel, R. Schwarz, J. Andon, T. Gerstenberger, R. Renner, K. C. Kececioglu, W. Morgan, L. Mercer, and A. Cattaneo Mar. 1981 412 p refs
(Contract DOT-HS-7-01790)
(PB81-247553; DOT-HS-805956) Avail: NTIS
HC A18/MF A01 CSCL 13F

A series of studies was conducted in support of the Office of Research and Development of the NHTSA in areas of automotive design and technology that could affect fuel economy. Nine such studies were carried out and included assessments of spark ignition engine: fuel economy improvement potential; potential of changes in rolling resistance, aerodynamic drag, accessory load and lubricants. Other studies included a study of the potential of alternative engines, a compilation of literature, and a preliminary assessment of diesel particulates. In addition to conducting studies based on a literature review and analysis, there were two hardware studies conducted in the form of teardown studies of selected passengar car (Ford Fairmont) and light truck (Chevy Luv)z models. GRA

N82-16948# Market Facts, Inc., Arlington, Va. Public Sector Research Group.
CONSUMER BEHAVIOR TOWARDS FUEL EFFICIENT VEHICLES, VOLUME 2 Final Report, Oct. 1977 - Mar. 1981
James T. Heisler and Sid Groeneman Mar. 1981 127 p
(Contract DOT-HS-7-01781)
(PB81-246654; DOT-HS-805937-Vol-2) Avail: NTIS
HC A07/MF A01 CSCL 10A

Information on likely market response to various vehicle design and performance changes is studied to minimize the possibility of market rejection. The report is based on focus group discussions and consumer experiments with drivers in different vehicle size classes. Analysis focuses on the believability of the energy crisis and concern about its effects, the acceptability of possible fuel economy options, consumer preferences with respect to vehicles embodying selected design and engineering changes, and predicted purchase and usage patterns under different future scenarios. GRA

N82-16950# Energy and Environmental Analysis, Inc., Arlington, Va.
DEVELOPMENT OF ADJUSTMENT FACTORS FOR ON ROAD FUEL ECONOMY Final Report
Robert Crawford, Peter Forshay, and Robert Dulla Mar. 1981 219 p refs
(Contract EPA-68-03-2888)
(PB81-241986; EPA-460/3-81-003) Avail: NTIS
HC A10/MF A01 CSCL 13F

The differences between EPA test-measured and actual on-road fuel economy were evaluated. It is expected that the methodology and the adjustment factors developed will form the basis for a labeling system that in future model years, will discount the EPA test measurements of new cars to estimate on road fuel economy. Because new cars employ a growing percentage of fuel efficient technologies having distinctly lower levels of shortfall than traditional ones, this analysis has carefully evaluated and to the extent that available data permit, quantified the shortfall of the alternative technologies. GRA

N82-16953# Transportation Systems Center, Cambridge, Mass.
AN INVESTIGATION OF TRUCK SIZE AND WEIGHT LIMITS: TECHNICAL SUPPLEMENT. VOLUME 3: TRUCK AND RAIL FUEL EFFECTS OF TRUCK SIZE AND WEIGHT LIMITS Final Report, Oct. 1978 - Jun. 1981
David A. Knapton Jul. 1981 142 p refs
(PB82-100538; DOT-TSC-OST-81-2) Avail: NTIS
HC A07/MF A01 CSCL 13E

Data and analytical methods to estimate probable changes in direct and indirect fuel consumption for new truck size and weight limits are presented. These effects are examined in terms of changes in the competitive relationships between highway and rail services. The method for estimating fuel consumption includes line haul and access fuel and makes allowance for the system fuel requirements of empty backhaul and circuitry. Single unit trucks, conventional tractor-semi-trailer, Western Doubles, Turnpike Doubles, and Triple Trailer combination rigs as well as the competitive carload boxcar and TOFC rail services are considered. Truck service (i.e., van, reefer, household moving van, flat bed, tanker and dump), and the competitive rail services are disaggregated. Author

N82-16958# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch.

EVALUATION OF THE MOLECULETOR FUEL ENERGIZER UNDER SECTION 511 OF THE MOTOR VEHICLE INFORMATION AND COST SAVINGS ACT

Gary T. Jones May 1981 121 p refs
(PB81-247942; EPA-AA-TEB-511-81-11) Avail: NTIS HC A06/MF A01 CSCL 13F

Results of an evaluation of a fuel saving device known as the Fuel Energizer Moleculetor are presented. The device is designed to be installed in the fuel line between the fuel tank and fuel pump. The applicant claims that as the fuel passes through the device, it becomes energized, burns more efficiently and therefore, provides improved fuel economy. GRA

N82-16959# Environmental Protection Agency, Ann Arbor, Mich. Office of Mobile Source Air Pollution Control.

EVALUATION OF THE IMPACT ON EMISSIONS AND FUEL ECONOMY OF CONVERTING TWO VEHICLES TO COMPRESSED NATURAL GAS FUEL

Thomas J. Penninga Jun. 1981 18 p
(PB81-245714; EPA-AA-TEB-81-19) Avail: NTIS HC A02/MF A01 CSCL 13F

The EPA was requested by the Department of Energy to perform testing on two late model vehicles which were converted with on-the-market systems to run on compressed natural gas (CNG). The EPA was requested to measure vehicle emissions, fuel economy, and acceleration characteristics of the vehicles in stock configuration, modified running on gasoline, and modified-running on natural gas. The testing was run over a three week period with triplicate tests run in each condition. The results of the testing are reported. It does not attempt to analyze the feasibility of CNG powered vehicles in the market place. GRA

N82-16965# Booz-Allen and Hamilton, Inc., Philadelphia, Pa. National Analysis, Inc.

CONSUMER ORIENTATIONS TOWARD FUEL EFFICIENT VEHICLES: EXECUTIVE SUMMARY Final Report, Feb. 1978 - Nov. 1980

Robert Kernish Mar. 1981 25 p
(Contract DOT-HS-7-01782)
(PB81-245359; Rept-1-037-78-ES; DOT-HS-805939) Avail: NTIS HC A02/MF A01 CSCL 21G

Consumer reactions both to specific vehicle design changes, and more generally, to the Corporate Average Fuel Economy (CAFE) regulations were investigated. The energy supply situation which motivated their implementation is also discussed in terms of consumer reactions. M.D.K.

N82-16966# Booz-Allen and Hamilton, Inc., Philadelphia, Pa. National Analysts, Inc.

CONSUMER ORIENTATIONS TOWARD FUEL EFFICIENT VEHICLES Final Report, Feb. 1978 - Nov. 1980

Robert Kernish Mar. 1981 118 p
(Contract DOT-HS-7-01782)
(PB81-245367; Rept-1-037-78-F; DOT-HS-805938) Avail: NTIS HC A06/MF A01 CSCL 21G

Consumer reactions to the energy supply situation and to the Corporate Average Fuel Economy (CAFE) regulations were considered. Reactions to specific vehicle design changes were also investigated and are summarized. M.D.K.

N82-17174*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

CF6 JET ENGINE PERFORMANCE IMPROVEMENT: HIGH PRESSURE TURBINE ROUNDNESS

W. D. Howard and W. A Fasching Jan. 1982 136 p refs
(Contract NAS3-20629)
(NASA-CR-165555; R82AEB115) Avail: NTIS HC A07/MF A01 CSCL 21E

An improved high pressure turbine stator reducing fuel consumption in current CF6-50 turbofan engines was developed. The feasibility of the roundness and clearance response improvements was demonstrated. Application of these improvements will result in a cruise SFC reduction of 0.22 percent for new engines. For high time engines, the improved roundness and response characteristics results in an 0.5 percent reduction in cruise SFC. A basic life capability of the improved HP turbine stator in over 800 simulated flight cycles without any sign of significant distress is shown. E.A.K.

N82-17407# Michigan Univ., Ann Arbor. Architectural Research Lab.

SOLARIZATION/CONSERVATION TECHNOLOGY DEVELOPMENT FOR EXISTING HOUSING Progress Report

W. Oberdick 1 Jun. 1981 34 p
(Contract DE-FG02-80R5-10227)
(DE82-002175; DOE/R5-10227/2) Avail: NTIS HC A03/MF A01

The project objectives were to develop a method for evaluating existing residences for their energy solarization/conservation potential as well as carrying out the solarization/conservation work within context of the Community Development program; and to demonstrate appropriate methods of utilizing solar energy in existing Ann Arbor residences beyond that obtainable in a good conservation program. A general progress update is presented covering tasks related to community solarization/conservation characteristics and community system analysis and development. The process of selection and technical evaluation of houses for solarization/conservation project directed retrofit is described. A detailed report on the survey of utility data and a report on the solarization/conservation site audits are included. A detailed comparison of the audit data for both the audit and control group are appended. DOE

N82-17512# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.

ROLLING RESISTANCE MEASUREMENTS 108 PASSENGER CAR TIRES

Gayle Klemer Aug. 1981 44 p refs
(PB82-116625; EPA-AA-SDSB-81-3) Avail: NTIS HC A03/MF A01 CSCL 13F

A diverse range of tires currently available on the replacement passenger car tire market is investigated. One hundred-six tires from fifty different lines were tested. The rolling resistance of these tires are analyzed against other tire characteristics (tire construction, new versus retread, etc.) to gain insight as to the effects of these characteristics on vehicle fuel economy. GRA

N82-17581# Nevada Univ. System, Reno. Water Resources Center.

WATER FOR NON-NUCLEAR ENERGY DEVELOPMENT IN THE GREAT BASIN

Sep. 1981 344 p refs Sponsored in part by Water Resources Council, Washington, D.C.
(PB82-116781) Avail: NTIS HC A15/MF A01 CSCL 13B

The availability of water to support conventional and emerging non-nuclear energy technologies under certain hypothetical world oil prices was assessed and major effects that these levels of energy development could have on the regions water resources were identified in an effort to aid national and regional energy supply planning and decision making. GRA

N82-17584# Energy Resources Co., Inc., Cambridge, Mass.

MONITORING TO DETECT GROUNDWATER PROBLEMS RESULTING FROM ENHANCED OIL RECOVERY Final Report

Ron Beck, Bernard Aboba, Douglas Miller, and Ivor Kaklins Oct. 1981 146 p refs
(Contract EPA-68-03-2648)
(PB82-119074; EPA-600/2-81-241) Avail: NTIS HC A07/MF A01 CSCL 08H

A four stage monitoring program to detect groundwater contamination events that may potentially result from enhanced oil recovery (EOR) projects was developed. The monitoring system is based on a statistical analysis evolving from a series of equations that model subsurface transport of EOR spills. Results of the design include spatial and frequency monitoring intervals that depend on properties of the local geology and dispersion characteristics of the potential contaminants. GRA

N82-17585# Ohio River Basin Commission, Cincinnati.

CUMBERLAND RIVER BASIN; REGIONAL WATER AND LAND RESOURCES PLAN

Jun. 1981 384 p refs Sponsored in part by Water Resources Council
(PB82-111501) Avail: NTIS HC A17/MF A01 CSCL 08H

The report is on the regional water resources management plan for the Cumberland River Basin in Virginia, Kentucky and Tennessee. An executive summary, recommended plans, and directions for the future are presented. M.D.K.

N82-17594# Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
REVEGETATING STRIP-MINED LAND WITH MUNICIPAL SEWAGE SLUDGE Final Report, Nov. 1976 - Oct. 1979
William E. Sopper and Sonja N. Kerr. Sep. 1981. 182 p. refs
Prepared in cooperation with Pennsylvania Dept. of Environmental Resources
(Grant EPA-S-804511)
(PB82-102484; EPA-600/2-81-182) Avail: NTIS HC A08/MF A01 CSCL 08I

Three sites representative of abandoned barren bituminous and anthracite mines were treated with various types of municipal sludge at high and low application rates and broadcast seeded with a mixture of greases and legumes. A monitoring system was installed at each demonstration site to determine the effects of the sludge applications on groundwater and soil percolate water chemical and bacteriological quality, chemical properties of the soil, and quality and growth of vegetative cover. GRA

N82-17616# Los Alamos Scientific Lab., N. Mex.
DOE-2 VERIFICATION PROJECT, PHASE 1 Interim Report
Stephen C. Diamond, Bruce D. Hunn, and Charlene C. Cappiello. Apr. 1981. 74 p. refs
(Contract W-7405-eng-36)
(LA-8295-MS) Avail: NTIS HC A04/MF A01

Phase 1, an analytical and empirical verification of DOE-2 as computational algorithms, is reported. DOE-2 is a computer program developed to provide architect/engineers with a public domain tool for energy analysis buildings. Results of a comparison of plant equipment performance default values with manufacturer's data, and results of a series of comparisons of DOE-2 solar simulator predictions with predictions of other solar system simulation computer programs. Results of empirical tests of the full DOE-2 program are also presented, including comparisons with measured monthly and annual energy consumption for seven commercial buildings located in seven different cities and for nine elementary schools. Comparisons of predicted results of several building energy analysis computer programs are reported. E.A.K.

N82-17619# Regensberg Univ. (West Germany). Inst. fuer Physik.
ASSESSMENT OF TECHNICAL POTENTIAL: PROBLEMS, METHODS AND RESULTS
G. Obemair *In* Kernsforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 17-28 (For primary document see N82-17617 08-44)
Avail: NTIS HC A06/MF A01

The technical and economic problems posed by the integration of wind energy into the electric power supply system are considered. Stability and control requirements, the efficiency of wind converters and the exclusion of technically inaccessable areas are applied to the stochastic wind field over the total area. The resulting technical potential is then reduced to an economic potential by applying an economic filter which involves competitiveness measured against other energy sources, comparative social costs and socio-economic preferences, and the actual cost and existing use of land for wind energy parks. J.D.H.

N82-17620# Regensberg Univ. (West Germany). Inst. fuer Volkswirtschaft.
ECONOMIC EVALUATION
L. Hoffman *In* Kernsforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 28-37 (For primary document see N82-17617 08-44)
Avail: NTIS HC A06/MF A01

The economic significance of wind energy is assessed on the basis of its potential contribution to Germany's energy supply, its competitiveness vis-a-vis other energy sources, and its social desirability, measured by its contribution to the realization of general socio-economic goals. J.D.H.

N82-17634# Argonne National Lab., Ill. Energy and Environmental Systems Div.
CUSTOMER ATTITUDES TOWARD THERMAL-ENERGY-STORAGE HEATING
H. N. Hersh. Jun. 1981. 74 p. refs
(Contract W-31-109-eng-38)
(DE82-003010; ANL-SPG-17) Avail: NTIS HC A04/MF A01

Attitudes among users of thermal energy storage (TES) heating systems were studied. A customer acceptance survey exploring attitudes and levels of satisfaction, face to face contacts between utility representatives and users, and a survey of pertinent published information are investigated. It is found that: (1) TES heating systems are installed for economic reasons by customers who can afford higher initial costs and understand the concept of lower total cost; and (2) attitudes toward TES are positive. The TES systems are not regarded more favorably than conventional systems, however, and it is likely that lower electric heating bills are responsible for the favorable perceptions of most TES users. DOE

N82-17654*# Old Dominion Univ., Norfolk, Va. Dept. of Economics.
ENERGY ENVIRONMENT STUDY Final Report, 16 May 1980 - 15 Mar. 1981
Raymond Strangways. Dec. 1981. 123 p. refs
(Contract NAG1-66)
(NASA-CR-168458) Avail: NTIS HC A06/MF A01 CSCL 13B

The international demand for and supply of oil between the years 1980 and 2000 is assessed and future world oil prices and their implications for the price of jet fuel are estimated. Three critical questions are investigated: (1) how long will the world supply of oil continue to keep pace with its demand under likely trends in its use and discovery; (2) at what price will demand and supply clear the world oil market; (3) what does the analysis imply about the price of jet fuel. Projection of oil price is based upon supply and demand, which is consistent with microeconomic analysis. E.A.K.

N82-17664# Rockwell International Corp., Newbury Park, Calif. Environmental Monitoring and Services Center.
ASSESSMENT OF OIL PRODUCTION VOLATILE ORGANIC COMPOUND SOURCES Final Report, Jan. - Sep. 1980
W. S. Eaton, G. R. Schneider, W. Unterberg, and F. G. Bush, III. Sep. 1981. 75 p
(Contract EPA-68-03-2648)
(PB82-108176; EPA-600/2-81-197) Avail: NTIS HC A04/MF A01 CSCL 13B

Oil and gas exploration and production drilling technology are described with emphasis on the makeup, use, and disposal of drilling fluids. A model for assessment of volatile organic compounds (VOC) emissions accompanying drilling is presented, along with an estimation of the potential VOC emissions associated with drilling activities. Emissions of volatile organic compounds from oil production in new fields were estimated, based on three types of information: (1) extent of new oil and gas fields (those that started production after 1974) in the contiguous 48 states; (2) drilling techniques used for oil and gas exploration and production wells (and their VOC potential), with specific emphasis on the drilling fluids; and (3) equipment and techniques for oil and gas production in new fields and their potential VOC sources. GRA

N82-17669# TRW, Inc., Research Triangle Park, N.C. Environmental Engineering Div.
PERFORMANCE EVALUATION OF AN INDUSTRIAL SPRAY DRYER FOR SO2 CONTROL Final Report, Mar. 1980 - Jun. 1981
James A. Kezerle, Steve W. Mulligan, Dave-Paul Dayton, and Patricia J. Perry. Aug. 1981. 274 p. refs. Prepared in cooperation with Celanese Fibers Company, Cumberland, Md. and Rockwell International, Downey, Calif., and Wheelabrator-Frye, Inc., Pittsburgh, Pa.
(Contract EPA-68-02-3174)
(PB82-110701; EPA-600/7-81-143) Avail: NTIS HC A12/MF A01 CSCL 13B

Results of a test to evaluate the SO2 removal performance of the lime-spray-dryer/fabric-filter system treating flue gas from the stoker-coal-fired boiler are presented. Continuous monitors were used to collect data according to EPA procedures for compliance testing. Data were collected for 23 days with the boiler operating at about half load. In addition to evaluating SO2 removal by dry flue gas desulfurization, operating experience with the boiler and spray-dryer/baghouse system was obtained for 5 months. Data were reduced to express SO2 removal on a mass per unit energy input basis as prescribed by EPA. Test

results showed the mean SO2 removal efficiency to be 70% (standard deviation of + or - 9%) when the sulfur content of the bituminous coal averaged 2%. T.M.

N82-17672# Louisville Gas and Electric Co., Ky.
PILOT FIELD STUDIES OF FGD WASTE DISPOSAL AT LOUISVILLE GAS AND ELECTRIC Final Report, May 1976 - Aug. 1979
R. P. VanNess, A. L. Plumley (Combustion Engineering, Inc., Windsor, Conn.), N. C. Mohn (Combustion Engineering, Inc., Windsor, Conn.), C. R. Ulrich (Louisville Univ., Kentucky), and D. J. Hagarty (Louisville Univ., Kentucky) 1981 314 p refs
(Contract EPA-68-02-2143)
(PB82-105479; EPA-600/7-81-155) Avail: NTIS HC A14/MF A01 CSCL 13B

The gas desulfurization (FGD) waste disposal was studied. It is shown that properly prepared landfill from FGD sludge/fly ash mixtures prevents trace element contamination of underlying groundwater. Small synthetically lined, above ground impoundments has higher concentrations of trace contaminants than subsurface impoundments. Most sites developed compressive strengths greater than the minimum required for recreational or light structural landfill. Water samples from beneath larger subsurface impoundments indicated that the filtering action of soil aids in decreasing the concentration of contaminants reaching the ground water supply. Certain mixtures under fixation reaction, reducing the permeability and minimizing the release of moisture and/or contaminants to the surrounding soil. GRA

N82-17678# Illinois Univ. at Urbana-Champaign.
POTENTIAL WATER QUANTITY AND WATER QUALITY IMPACTS OF POWER PLANT DEVELOPMENT SCENARIOS ON MAJOR RIVERS IN THE OHIO BASIN
E. Downey Brill, Jr., Shoou-Yuh Chang, Robert W. Fuessle, and Randolph M. Lyon Apr. 1981 225 p refs
(Grant EPA-R-805588)
(PB82-102401; EPA-600/7-81-045) Avail: NTIS HC A10/MF A01 CSCL 13B

Water consumption levels associated with power plant cooling were estimated for different energy development scenarios for the Ohio River Basin potential impacts of power plant consumption and pollutant emissions on ambient water quality were also estimated. Cumulative water consumption was compared to the 7 day 10 year low flow values for various locations along the tributaries and main stem of the Ohio River. The total potential consumption associated with projected municipal and non power industrial was evaluated. Potential water quality impacts were estimated. Potential impacts on water quality result mainly from plant consumption are generally small in comparison to background levels. GRA

N82-17684# Tennessee Valley Authority, Muscle Shoals, Ala. Div. of Energy Demonstrations and Technology.
DEFINITIVE SOx CONTROL PROCESS EVALUATIONS: AQUEOUS CARBONATE AND WELLMAN-LORD (ACID, ALLIED CHEMICAL, AND RESOX) FGD (FLUE GAS DESULFURIZATION) TECHNOLOGIES Final Report, Apr. 1978 - Apr. 1981
J. R. Byrd, K. D. Anderson, S. V. Tomlinson, and R. L. Torstrick Jun. 1981 319 p refs
(Contract EPA-IAG-D9-3721-B1)
(PB82-118670; EPA-600/7-81-099; EDT-121) Avail: NTIS HC A14/MF A01 CSCL 13B

Economic evaluations of two processes: (1) the aqueous carbonate process (ACP) and the Wellman-Lord process, applied to a sulfuric acid plant, (2) the Resox process, and the coal reduction process, all for sulfur production are reported. The ACP uses a spray dryer flue gas desulfurization (FGD) system and molten salt reduction with coal to make sulfur. The ACP has a major cost advantage because it incorporates final fly ash and chloride removal as process functions. The ACP has a major advantage in annual revenue requirements because it does not need process or reheat steam. Wellman-Lord process costs are the same for all three applications. GRA

N82-17742 Illinois Univ. at Urbana-Champaign.
CLIMATIC INFLUENCES OF RESIDENTIAL ENERGY CONSUMPTION Ph.D. Thesis
Stewart Jay Cohen 1981 193 p
Avail: Univ. Microfilms Order No. 8127570

A climatic index, applicable to the estimation of residential energy consumption was developed. The index is based on seasonal frequencies of upper-air (500-mb height) circulation patterns. A multivariate statical technique, principal component analysis with oblique rotation of eigenvectors was used to classify 33 years of daily 500-mb height anomaly, patterns into 30 components. Each component represents two modes, positive and inverse, thereby resulting in sixty 500-mb types. Additional aggregation procedures reduced the number of types to 48. 78% of all days were categorized by this method. Two sets of regression analyses were performed on the data base, on set using 500-mb type frequencies, the other using population weighted heating degree days (POPHDD) and unweighted heating degree days (HDD). Results show that the 500-mb type frequency is a better climatic index of long term residential natural gas consumption than either HDD or POPHDD. Dissert. Abstr.

N82-17763# Stockholm Univ. (Sweden). Dept. of Meteorology.
INCREASE OF ATMOSPHERIC CO2 AND POSSIBLE CLIMATIC CHANGES
Bert Bolin *In* WMO Tech. Conf. on Climate: Asia and Western Pacific 1981 p 227-238 refs

Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

Numerous surveys of man's impact on climate, particularly the possible effects of an increasing concentration of atmospheric CO2 were made. A brief account summarizing the state of knowledge in this regard is made. Consideration is given to: (1) the characteristics of the carbon cycle and its response to man-made emissions to the atmosphere; (2) the climatic change that may be induced by an increasing amount of CO2 in the atmosphere; and (3) the likely developments over the next 50 years as a result of man's increasing exploitation of the global resources of fossil fuels and the terrestrial ecosystems. Analysis of the way in which the carbon cycle responds to disturbances due to man, i.e., fossil fuel combustion, deforestation and expansion of agriculture is considered to be of particular importance. M.D.K.

N82-17764# Leeds Univ. (England). School of Geography.
ENERGY AND CLIMATE IN SOUTH-EAST ASIA AND THE WESTERN PACIFIC
G. J. Lockwood *In* WMO Tech. Conf. on Climate: Asia and Western Pacific 1981 p 239-263 refs

Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

Regional and global aspects of energy use were reviewed. The combined results of population increases, changing patterns of population densities, and escalating per capita energy consumption has concentrated in some regions of the world very large energy fluxes per unit area (energy flux density) when compared with the world average; consequences are considered. Climate is discussed as related to increasing energy use in three major areas: (1) climate as an energy source; (2) pollution of the atmosphere by energy use (waste heat and aerosols); and (3) climatic controls on energy use and the effects of climatic variations. Long term climatic changes and the attendant economic consequences of increased atmospheric carbon dioxide are discussed. Utilization of wind, water, and solar power as climate related energy sources is also considered. M.D.K.

N82-17765# National Oceanic and Atmospheric Administration, Rockville, Md. National Climate Program Office.
APPLICATIONS OF CLIMATE INFORMATION AND THE UNITED STATES NATIONAL CLIMATE PROGRAM
Edward S. Epstein *In* WMO Tech. Conf. on Climate: Asia and Western Pacific 1981 p 264-266

Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

The United States National Climate Program established with the purpose of assisting the Nation and the world to understand and respond to natural and man-induced climate processes and their implications is discussed. The basic strategy of the program is to emphasize early production of useful data and information based on existing knowledge of climate, while simultaneously expanding understanding of climate and its impacts on society. Three areas discussed in which progress should be made are:

(1) understanding climate; (2) responding to impacts and policy implications of climate; and (3) providing climate products. The generation, dissemination and application of climate information and the creation and utilization of national data inventory and clearinghouse is also discussed. A summation of current activity areas within the program is presented. M.D.K.

N82-17766# World Meteorological Organization, Geneva (Switzerland).
STUDY OF CLIMATE AND ITS APPLIED ASPECTS
E. P. Borisenkov (USSR) and N. V. Kobysheva (USSR) *In its* Tech. Conf. on Climate: Asia and Western Pacific 1981 p 267-273
Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

The need for a reliable scientific basis for estimating the climate effect on the economic, biological and social aspects of society is considered. The foundation of this basis should include: knowledge of the general statistical characteristics of climate and its changeability for different regions and the whole globe and the methods for their consideration when forming a long-term plan of production development; and knowledge of the effect of climatic extremes on different aspects of economic and social life. The effect of climatic change on agriculture, on agricultural energy consumption, energy production, water resource management, and consequences of climatic variations on fish industry and human health is discussed. Methods for optimal consideration of future climate in planning man's economic activities are also discussed. M.D.K.

N82-18066*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
VEHICLE TEST REPORT: ELECTRIC VEHICLE ASSOCIATES ELECTRIC CONVERSION OF AN AMC PACER
Theodore W. Price, Vincent A. Wirth, Jr., and Michael F. Pompa 15 Oct. 1981 61 p refs
(Contracts NAS7-100; DE-AI01-78CS-54209)
(NASA-CR-168425; JPL-Pub-81-97; DOE/CS-54209/4) Avail: NTIS HC A04/ A01 CSCL 13F

Tests were performed to characterize certain parameters of the EVA Pacer and to provide baseline data that can be used for the comparison of improved batteries that may be incorporated into the vehicle at a later time. The vehicle tests were concentrated on the electrical drive subsystem; i.e., the batteries, controller and motor. The tests included coastdowns to characterize the road load, and range evaluations for both cyclic and constant speed conditions. A qualitative evaluation of the vehicle's performance was made by comparing its constant speed range performance with other electric and hybrid vehicles. The Pacer performance was approximately equal to the majority of those vehicles assessed in 1977. A.R.H.

N82-18068*# Department of Transportation, Cambridge, Mass.
FUEL ECONOMY AND EXHAUST EMISSIONS CHARACTERISTICS OF DIESEL VEHICLES: TEST RESULTS OF A PROTOTYPE FIAT 131TC 2.4 LITER AUTOMOBILE
S. S. Quayle Jan. 1982 58 p refs
(NASA Order C-32817-D; Contract DE-AI01-80CS-50194)
(NASA-CR-165535; DOE/NASA/2817-2; DOT-TSC-NASA-81-2) Avail: NTIS HC A04/MF A01 CSCL 13F

The results obtained from fuel economy and emission tests conducted on a prototype Fiat 131 turbocharged diesel vehicle are presented. The vehicle was tested on a chassis dynamometer over selected drive cycles and steady-state conditions. Two fuels were used, a United States number 2 diesel and a European diesel fuel. Particulate emission rates were calculated from dilution tunnel measurements and large volume particulate samples were collected for biological and chemical analysis. It was determined that turbocharging accompanied by complementary modifications results in small but substantial improvements in regulated emissions, fuel economy, and performance. Notably, particulate levels were reduced by 30 percent. Author

N82-18070# Open Univ., Milton (England). Energy Research Group.
COMMUNICATION AND INTEGRATION WITHIN THE AGRICULTURE WATER, WASTE, AND ENERGY INDUSTRIES
D. C. Andrews Sep. 1980 28 p refs
(ERG-033) Avail: NTIS HC A03/MF A01

The special area of interest lies in the possible benefits of integrating and coordinating the activities of the agriculture, water, waste and energy (AWWE) sectors, where large cash and energy savings seem possible. The integration of the AWWE sectors is a specific example, but the comments and methods suggested are general in their application to complex problem-solving areas. A general method is described which, compared with conventional research, makes the collection of information on potential integration and coordination of any complex activities much easier. It also makes it more likely that the information is relevant and correct but, above all, the method ensures that any useful results of the research will be brought to the attention of relevant policy makers, with therefore a better chance that such results will be acted upon. Lateral access networks are proposed as a general means of achieving these practical benefits. J.M.S.

N82-18071# McElroy (Ralph) Co., Austin, Tex.
POSSIBILITY FOR ENERGY CONSERVATION IN TRANSPORTING FREIGHT BY TRUCK
M. Millar Sep. 1981 20 p Transl. into ENGLISH from Symp. on Evaluation and Reinforcement of Pavements and Energy in Transportation, Argentina, 1980 p 121-30 Symp. held in San Miguel de Tucuman, Argentina, 4-6 Sep. 1980 Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE81-030072; ANL-Trans-1199) Avail: NTIS HC A02/MF A01

Increasing energy efficiency in transporting freight by truck in interurban areas is discussed. Technical parameters to improve fuel economy are: (1) efficiency of the engine and drive train;(2) rolling resistance; (3) gross weight of the vehicle; (4) accessory load; and (5) aerodynamic resistance. Operating procedures to improve fuel economy are also discussed. Savings obtained up to the present in the USA due to the use of these various devices are summarized. DOE

N82-18073# Open Univ., Milton (England). Energy Research Group.
ELECTRIC VEHICLE REFUELLING INFRASTRUCTURE
Mike Baker Oct. 1981 69 p refs
(ERG-038) Avail: NTIS HC A04/MF A01; Secy. Energy Research Group, Milton Keynes, England

Energy and economic aspects of refueling infrastructures required in 2025 by complete fleets of electric battery and coal derived liquid fuel powered road vehicles are compared. Data are drawn from a study of the United Kingdom. The electric car is cheaper than the liquid powered one. If battery exchange is discounted, all electric vehicles have lower fuel costs than their equivalent. The electric vehicle alternative shows a very large saving in both primary energy and running cost. It requires a much smaller installed electricity generating capacity whose load factor is such that it can be totally nuclear. Author (ESA)

N82-18078# Federal Highway Administration, Washington, D.C. Office of Research and Development.
A METHOD FOR ESTIMATING FUEL CONSUMPTION AND VEHICLE EMISSIONS ON URBAN ARTERIALS AND NETWORKS
Juri Raus Apr. 1981 60 p refs
(PB82-108523; FHWA/TS-81/210) Avail: NTIS HC A04/MF A01 CSCL 13F

A method to estimate motor vehicle fuel consumption and vehicle emissions in an urban driving environment which requires a minimum of field data collection and processing effort was developed. Average transient speed measured by travel time is a good composite parameter reflecting stops and slowdowns and is closely correlated with fuel consumption and vehicle emission rates. Data were obtained for fuel speed and emission speed profiles for a 1980 typical mix of passenger cars, single unit trucks, tractor trailers and busses. Data and computational procedure provide an approach for estimating fuel consumption and emissions and can be used to gain insight into existing traffic operations and the merits of proposed or actual flow improvements. GRA

N82-18120# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
DEVELOPMENTS IN ROTARY WING AIRCRAFT AERODY-

NAMICS
I. C. Cheeseman *In* DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 27 p refs

Avail: NTIS HC A99/MF A01

Developments in helicopter aerodynamics are reviewed, including new blade sections and planforms. Computer modelling of the flow and the need for further work in predicting oscillating loadings are considered. The greater attention being given to the need to reduce drag in forward flight due to extended range and fuel conservation costs is recognized. A forecast of advances is made.
N.W.

N82-18134# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
COMPONENT DESIGN AND DEVELOPMENT FOR FUTURE HELICOPTER ENGINES
Jean Hourmouziadis and Horst B. Kreiner *In* DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 19 p refs
Avail: NTIS HC A99/MF A01

Advances achieved today and results available from both rig and demonstrator test programs for present and future helicopter engines are discussed. These will form the basis for further component improvement required to yield a successful next generation engine. The significance of reduced fuel consumption, improved overall system performance, and reliability are considered in relation to design activity and reaction to changing customer needs.
M.D.K.

N82-18174# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
[AVIATION AND SPACE FLIGHT RESEARCH ACTIVITIES] Annual Report, 1980 [JAHRESBERICHT 1980]
Sep. 1981 176 p refs In GERMAN
Avail: NTIS HC A09/MF A01

Results on the main research projects conducted in 1980 are described in the areas of transport and communication systems, airplanes, space flight techniques, exploration techniques, and energy and turbomachinery techniques. The improvement of reliability and security in transportation is a common feature of all projects. Aviation research is focussed on projects such as AIRBUS, fighter aircraft, and helicopters. Spacelab and the development of suitable payloads are the central issues of the space research effort with emphasis on material and processing techniques as well as biophysics and biomedicine. Data acquisition, using sensors and processing of satellite and Spacelab data is actively pursued. Recent developments in the domain of turbomachinery, nonnuclear energy research, energy conservation, and high energy laser techniques are also discussed.
Author (ESA)

N82-18207# General Accounting Office, Washington, D. C.
POTENTIAL REDUCTIONS IN AIRCRAFT OPERATION AND MAINTENANCE COSTS BY USING THRUST COMPUTING SUPPORT EQUIPMENT Report to the Honorable Joseph P. Addabbo, Chairman, Subcommittee on Defense, Committee on Appropriations, House of Representatives
27 Oct. 1981 17 p
(AD-A108463; GAO/PLRD-82-4) Avail: NTIS HC A02/MF A01 CSCL 01/2

This report addresses the evaluation of thrust measuring equipment. We interviewed Air Force officials and contractor representatives, reviewed documentation pertaining to the key events in the evaluation of the thrust computing system program, reviewed test data and analyses by Air Force and contractor engineers, and observed the operation of the thrust computing system. Our analyses show that the accurate measurement and setting of thrust for installed jet engines is of vital importance not only for aircraft readiness and safety but also for operation and maintenance cost reductions. Although test results indicate that a system is available that can perform such measurements, the services have not been using it. The Air Force has conducted extensive tests that will measure thrust for installed J85-5 engines, but has not implemented a system. The Navy has not performed any tests to determine whether its aircraft jet engines might benefit from such a system.
GRA

N82-18306# Office of Technology Assessment, Washington, D. C.
SOLAR POWER SATELLITES, SUMMARY
Aug. 1981 22 p
(OTA-E-145) Avail: NTIS HC A02/MF A01

The energy potential of the solar power satellite (SPS) was assessed. The preliminary nature of SPS technology was taken into account by comparing four alternative SPS systems across a broad range of issues: their technical characteristics long term energy supply potential, international and military implications, environmental impacts, and institutional effects. The SPS options were also compared to potentially competitive energy technologies in order to identify how choices among them might be made. In addition, a set of Federal research and funding options were developed to address the central questions and uncertainties identified in the report.
S.L.

N82-18333# Cambridge Univ. (England). Dept. of Engineering.
MICROMECHANISMS OF FRACTURE AND HYPOTHERMAL AGING OF FIBROUS COMPOSITES Final Report, 1 Aug. 1978 - 31 Dec. 1980
Peter W. R. Beaumont 28 Feb. 1981 73 p refs
(Grant AF-AFOSR-3644-78; AF Proj. 2307)
(PB82-121369; CUED/C-MAT/TR-76-181) Avail: NTIS HC A04/MF A01 CSCL 11D

The micromechanisms of crack extension of carbon fibers, glass fibers, and hybrid composites containing glass fibers, and carbon fibers in epoxy and polyester resins were studied. A new collection of failure data based on observations of fibers debonding snapping and pulling out was summarized in cumulative probability diagrams and analyzed using Weibull distribution parameters. This data, together with models of failure processes and information of work of fracture, is used to construct fracture mechanism diagrams. These diagrams, together with the Weibull parameters may help in distinguishing between mechanisms of fracture give guidance in selecting a material system and in isolating aging and environmental effects.
Author (GRA)

N82-18338 Illinois Univ. at Urbana-Champaign.
SELECTIVE JET PLATING Ph.D. Thesis
Tan-Jen Chen 1981 204 p
Avail: Univ. Microfilms Order No. 8127565

The use of an unsubmerged impinging jet system for selective plating is proposed. A theoretical analysis, which accounted for the charge transfer, mass transfer, and ohmic resistance effects, was developed to predict the current distributions along the cathode. Three electrochemical systems were employed in an experimental jet plating cell to demonstrate the validity of the model. The current distributions were measured with controlled variation of jet Reynolds number, nozzle-to-cathode distance, solution specific conductivity, and reactant concentration. Upon demonstrated to be valid, the theoretical model was used to predict the cell performance under a wide range of parameter values.
Dissert. Abstr.

N82-18340 Minnesota Univ., Minneapolis.
EXPERIMENTAL AND THEORETICAL STUDIES ON GAS CYCLONE SEPARATORS OPERATING AT HIGH EFFICIENCY Ph.D. Thesis
Thinh Van Tran 1981 161 p
Avail: Univ. Microfilms Order No. 8126034

It was shown that wall friction has negligible effect on particle motion, but dust particles on the wall move much more slowly than the surrounding gas, due to crowding. It was found that re-entrainment of particles in the region near the cone apex of a cyclone is a significant factor affecting collection efficiency of low and moderate efficiency cyclones. A theory on the secondary flow along the cone wall was developed. Short circuit flow on the top of a cyclone was also studied. The effect of this flow on efficiency was also studied. The secondary flow velocity was found to be dependent on inlet geometry and is of order of 15% that of the main flow. A simplified theory was developed to give the flow field in gas cyclones. It was shown that the particle volume fraction inside the dust spiral on a cyclone wall is of the same order as the emulsion phase in fluidized systems.
Dissert. Abstr.

N82-18341 Louisiana State Univ. and A&M Coll., Baton Rouge.
FREQUENCY RESPONSE ANALYSIS OF DISTILLATION COLUMN INTERACTION Ph.D. Thesis
Chien Wang 1981 338 p

Avail: Univ. Microfilms Order No. 8126983

A dynamic pressure model of multicomponent distillation is developed in the frequency domain. The model consists of a set of linearized overall and component balances, enthalpy balance, pressure relationship, hydraulic equation and equilibrium relationships for each tray, the condenser and the reboiler of a general column. A numerical method consisting of total scaled pivoting Gaussian elimination with the method of residues is worked out for solving the model in the frequency domain to obtain all of the desired transfer functions. As a result, this analysis can be useful in defining the control problem and predicting interaction difficulties. The computer program developed can be used to study the effect of different model simplifying assumptions. The models studied were pressure model, enthalpy model and quimolar overflow model. A steady state program and a mechanical design program were also developed.

Dissert. Abstr.

N82-18342# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Earth Sciences Branch.

IDENTIFYING AND DETERMINING HALOCARBONS IN WATER USING HEADSPACE GAS CHROMATOGRAPHY

Daniel C. Leggett Oct. 1981 17 p refs

(Proj. CWIS-31281)

(AD-A108345; CRREL-SR-81-26) Avail: NTIS HC A02/MF A01 CSCL 07/4

Since the discovery that chloroform and other haloforms are produced during water chlorination, methods have been needed for their routine analysis. This report describes the application of the multiple equilibration headspace technique for the determination of halocarbons in water. This method has certain advantages over solvent extraction and direct injection techniques, including greater sensitivity because of the favorable gas/liquid distribution ratios. It is simpler and faster than purge and trap and resin sorption methods and gives more information about compound indentity than single headspace analysis because gas/liquid distribution ratios are determined experimentally. The method is absolute, unlike solvent extraction, resin sorption, purge and trap, and conventional headspace analysis, which require standard additions to correct for incomplete recovery. The use of the technique to analyze chlorinated water samples for haloforms revealed a potential problem in their analysis. Haloforms continued to form for 24 hours, even after destruction of chlorine residuals with thiosulfate. Maximum haloform concentrations were observed in undechlorinated samples only after a 48 hour aging period. GRA

N82-18552# Ferngas Nordbayern G.m.b.H., Bamberg (West Germany).

REPORT ON THE EXPERIENCES WITH THE GAS COMPRESSION HEAT PUMP SYSTEM OF THE SCHOOL AND SPORTS CENTER AT ALTENKUNSTADT Final Report, Dec. 1980

Fritz Tscherter Bonn Bundesministerium fuer Forschung und Technologie Oct. 1981 109 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-81-175; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 23,10

Three years of operation of a 1200 kw natural gas boiler system supplemented by a 800 kw gas heat pump system are evaluated and the savings in primary energy are assessed. Setup, control system and measuring instrumentation are described. The proximity of a river allows an hybrid operation whereby 100% of the heat is produced by the gas powdered heat pump for any river temperature above 3 C whereas below that temperature the gas boiler takes over completely. Annual heat pump heating figures between 1.66 and 1.72 were obtained, thus yielding a saving in primary energy between 36% and 47%, in good agreement with the design values. The cost analysis shows that the savings thus achieved cover the operating costs specific to the heat pump. Author (ESA)

N82-18553# Thermo Electron Corp., Waltham, Mass.

OPEN-CYCLE VAPOR COMPRESSION HEAT PUMP Annual Progress Report, 1980

Ravi Sakhuja and Frederick E. Becker 5 May 1981 54 p

(Contract GRI-5011-342-0094)

(PB82-110503; TE4224-243-81; GRI-80/0064) Avail: NTIS HC A04/MF A01 CSCL 13A

Recovery and upgrading of low-grade steam or waste heat sources offers a great potential of energy conservation. Thermo Electron is developing an open cycle vapor compression steam heat pump to meet this objective. The system utilizes excess low-pressure steam or that produced from an industrial excess heat source with a waste heat boiler and compresses this steam to the desired pressure level for process use. The compressor is driven by a prime mover such as a gas turbine, gas engine, etc. The prime mover exhaust heat also can be recovered to generate additional process steam. The fuel consumption of this system can be as low as 30 to 50 percent in comparison to a direct-fired boiler over the expected range of process conditions. Simple payback periods as low as one year can be achieved. GRA

N82-18568# Rockwell International Corp., Newbury Park, Calif. Environmental Monitoring and Services Center.

DEVELOPMENT OF A MULTIDETECTOR PETROLEUM OIL IN WATER MONITOR Final Report, May 1978 - Jan. 1981

Robert W. Melvold Sep. 1981 90 p refs

(Contract EPA-68-03-2648)

(PB82-105206; EPA-600/2-81-206) Avail: NTIS HC A05/MF A01 CSCL 14B

A prototype petroleum oil-in-water monitoring system that continuously measures oil (whether free, suspended, dissolved, or emulsified) in water carrying a variety of potential interfering substances was developed. An extensive desk-top survey of commercially available oil monitors was carried out. Three devices were selected for thorough laboratory evaluation: (1) Sigrist Fluorescence Monitor Model FLJ, (2) CE Invalco D.O.W. Monitor, and (3) Horiba OCMA-25 Oil Content Monitor. The construction of a flow loop and its operation, the installation of the selected detectors in the breadboard system, the development of a data retrieval system, the calibration methodology employed, the initial checkout of the detectors, and the extensive multidetector evaluation of each detector's performance for quantifying petroleum oil in the presence of impurities and other interferents are described. GRA

N82-18679# Indiana Univ., Bloomington. School of Public and Environmental Affairs.

A LAND USE ANALYSIS OF EXISTING AND POTENTIAL COAL SURFACE MINING AREAS IN THE OHIO RIVER BASIN ENERGY STUDY REGION

Daniel E. Willard, Michael A. Ewert, Mary Ellen Hogan, and Jeffrey D. Martin Apr. 1981 136 p refs

(Contract EPA-R-805588)

(PB82-105172; EPA-600/7-81-068) Avail: NTIS HC A07/MF A01 CSCL 08I

The land use changes resulting from the surface mining of coal in the Ohio River Basin, which depend on the distribution of the coal, the economic attractiveness of the coal demand, rigor and effectiveness of regulatory mechanisms, and the resilience of the existing ecosystems are reported. The three levels of coal demand assumed are taken from ORBES scenarios. The study analyzes existing industrial and governmental data on distribution, availability, and extraction of strippable coal. The history of reclamation enforcement and compliance is examined, and several potential land use results of the Federal Surface Mining Control and Reclamation Act of 1977 are analyzed. All of these factors are compared to existing patterns of topography, agriculture, and forestry. GRA

N82-18680# Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.

COAL MINE SITING FOR THE OHIO RIVER BASIN ENERGY STUDY

Donald A. Biorne Sep. 1981 180 p refs

(Grant EPA-R-805590)

(PB82-108119; EPA-600/7-81-116) Avail: NTIS HC A09/MF A01 CSCL 08I

In part 1, an overview of the ORBES region coal industry is presented. (The region consists of all of Kentucky, most of West Virginia, and substantial portions of Illinois, Indiana, Ohio, and Pennsylvania). Topics include coal production, mine types, reserves, selected coal properties, coal markets, employment, working conditions, wages, and quality of life. In part 2, the procedures for siting coal mines under the ORBES energy development scenarios are set forth. The coal mine siting analysis projects at the county level the number and type of new coal mines that would be opened in the ORBES region through the year 2000

under various scenario conditions and constraints. Among these conditions and constraints are the locational siting pattern of additional power plants in each scenario, the total coal production specified for the year 2000 by the ORBES energy demand model, and the sources of high and low sulfur coal, by mine type, specified by the ORBES coal supply analysis. GRA

N82-18700# Friends of the Earth, San Francisco, Calif.
ENERGY POLICIES FOR RESILIENCE AND NATIONAL SECURITY Final Report
Amory B. Lovins and L. Hunter Lovins Oct. 1981 322 p refs
(Contract DCPA01-79-C-0317)
(AD-A108263) Avail: NTIS HC A14/MF A01 CSCL 15/3

The vulnerabilities of the U.S. energy system to accidental or deliberate disruptions are analyzed generically and specifically and shown to be disturbingly large. Since they arise from reliance on highly centralized technologies, increasing such reliance is likely to increase national energy vulnerability. A more efficient, diverse, dispersed, renewable energy system is shown to be inherently more resilient, to make major failures impossible, and to be compatible with consistent adherence to free-market principles. Author (GRA)

N82-18701# Central Wayne County Sanitation Authority, Dearborn Heights, Mich.
FEASIBILITY STUDY ON ENERGY RECOVERY AND COGENERATION FROM AN EXISTING MUNICIPAL INCINERATOR, PHASE 1 Final Report
Jul. 1981 458 p refs
(Contract DE-FG01-79CS-20232)
(DE82-001143; DOE/CS-20232/1) Avail: NTIS HC A20/MF A01

A feasibility study of recovering and converting incinerator waste heat energy into steam and electricity for use in the facility with excess electricity being sold to the local utility was made. Energy recovery would be accomplished by retrofitting each furnace with a waste heat boiler and producing steam for heating and for driving steam turbine electric generators. Preliminary designs economic analyses, and financial plans were prepared. The quantity of municipal refuse was identified and the electric revenues needed for project justification were calculated. For the purpose of obtaining accurate design data, field tests were carried out on the actual refuse and combustion process. DOE

N82-18707# Service de la Programmation de la Politique Scientifique, Brussels (Belgium).
NATIONAL ENERGY RESEARCH AND DEVELOPMENT PROGRAM [PROGRAMME NATIONAL DE RECHERCHE-DEVELOPPEMENT DANS LE DOMAINE DE L'ENERGIE]
1980 23 p In FRENCH
Avail: NTIS HC A02/MF A01

This bibliography cites 24 reports generated by a program designed to study the national energy system, possibilities for energy conservation, and the use of new energy sources in Belgium. Topics covered include a mathematical model of the energy system; social impacts; regional aspects; the energy infrastructure; compatibilities, energy consumption in buildings and industries; the use of solar energy; heat recovery and storage; and the use of fossil fuels. Transl. by A.R.H.

N82-18708# Technische Hogeschool, Delft (Netherlands). Lab. for Thermal Power Engineering.
CYCLE: A GENERAL COMPUTER CODE FOR THERMODYNAMIC CYCLE COMPUTATIONS. STUDIES OF COGENERATION IN DISTRICT HEATING SYSTEMS
J. A. Miedema Sep. 1981 272 p refs
(WTHD-135) Avail: NTIS HC A12/MF A01

Computer programs which determine the energy consumption of heat power units, calculate the energy consumed by large scale district heating systems, compute the energy consumption per unit heat (f factor), and estimate the effect of dual purpose units on energy production/consumption of a regional scale power network were developed. District heating systems were assessed, using the programs. Systems with steam and gas units have lowest f factors. Regional power production efficiency is influenced by dual purpose units. The influence must be calculated for each case separately. Accurate computation of the f factor is urged since it is directly linked to the benefits/cost ratio. Author (ESA)

N82-18724# National Bureau of Standards, Washington, D.C. Center for Building Technology.
ENERGY MANAGEMENT AND CONTROL SYSTEMS (EMCS) USER SATISFACTION STUDY
Gary W. Dickinson Aug. 1981 20 p refs Sponsored in part by DOE, Washington, D.C.
(PB82-103656; NBSIR-81-2346) Avail: NTIS HC A02/MF A01 CSCL 13A

A study of 86 energy management and control systems (EMCS) was made. Users' satisfaction and perceived system reliability was determined. GRA

N82-18728# National Bureau of Standards, Washington, D.C. Center for Building Technology.
PERFORMANCE OF THE NORRIS COTTON FEDERAL OFFICE BUILDING FOR THE FIRST 3 YEARS OF OPERATION Final Building Sciences Series
James E. Hill, William B. May, Jr., Thomas E. Richtmyer, Jacqueline Elder, Robert L. Tibbott, Gary T. Yonemura, Charles M. Hunt, and Phillip T. Chen Aug. 1981 143 p refs Sponsored in part by DOE, Washington, D.C.
(PB82-105487; NBS-BSS-133; LC-81-600082) Avail: NTIS HC A07/MF A01 CSCL 13A

The Norris Cotton Federal Office Building, designed to demonstrate a number of energy saving concepts, is discussed. Some of the major energy conserving features of the building are the use of solar collectors; heavy masonry construction with exterior insulation; small overall window area; heat recovery from heat pumps, chillers, a natural gas-powered engine/generator, and the ventilation system; modular boilers; thermal storage tanks; and a variety of energy conserving lighting systems. GRA

N82-18731# Midland-Ross Corp., Toledo, Ohio. Thermal Systems Technical Center.
INDUSTRIAL BURNER AND PROCESS EFFICIENCY PROGRAM Annual Report, Jan. - Dec. 1980
S. R. Huebner and S. N. Prakash Mar. 1981 96 p refs
(GRI Proj. 5011-342-0148)
(PB82-115486; GRI-80/0059; Rept-1228) Avail: NTIS HC A05/MF A01 CSCL 13A

A laboratory prototype burner which is compatible with a FM (frequency modulation) combustion control system where temperature control is accomplished by regulating the ratio of burner on-time to burner off-time was developed. This multifuel (natural gas and No. 2 fuel oil) high velocity burner is capable of repeated pulse ignition at maximum rated capability (1 million Btu-hour) with preheated air (from ambient to 1100F). A digital control in the FM mode was developed. Experimental data from tests in a laboratory furnace indicated that when applied to a batch type thermal process where appreciable turndown is presently obtained by excess air operation, the FM combustion system provides improvements in process fuel efficiency and gains in productivity. Author

N82-18732# Carltech Associates, Columbia, Md.
GEOTHERMAL ENERGY MARKET STUDY ON THE ATLANTIC COASTAL PLAIN: TECHNICAL FEASIBILITY OF USE OF EASTERN GEOTHERMAL ENERGY IN VACUUM DISTILLATION OF ETHANOL FUEL
J. Carl Uhrmacher Apr. 1981 35 p refs Prepared for APL, Laurel, Md.
(Contracts EX-78-A38-1008; DE-AI01-79FT-27025; N00024-81-C-5301)
(PB82-123001; JHU/APL/QM-81-066) Avail: NTIS HC A03/MF A01 CSCL 07A

The application of modest temperature geothermal water in combination with a vacuum system for the distillation of fuel grade ethanol is analyzed. The case analyzed was for geothermal water temperatures typical of what might be found on the Atlantic Coastal Plain, i.e., 150 F, and a vacuum of 130 mm Hg, i.e., currently in use in a farm scale vacuum distillation system in Ohio. GRA

N82-18733# National Oceanic and Atmospheric Administration, Washington, D. C.
COMMERCIAL OCEAN THERMAL ENERGY CONVERSION (OTEC) LICENSING FINAL ENVIRONMENT IMPACT STATEMENT Final Environmental Impact Statement
Jul. 1981 284 p refs
(PB82-117532; NOAA-81082705) Avail: NTIS HC A13/MF A01 CSCL 10B

The effects of licensing commercial ocean thermal energy conversion (OTEC) development on human activities and the atmospheric, marine and terrestrial environments are identified and assessed. Alternate regulatory approaches for mitigating adverse environmental impacts associated with siting, design, and operation of commercial OTEC plants are evaluated, and the preferred regulatory alternative identified. Author (GRA)

N82-18734# Illinois Univ. at Chicago Circle, Chicago.
ENERGY CONSUMPTION PATTERNS: ILLINOIS, INDIANA, KENTUCKY, OHIO, PENNSYLVANIA, AND WEST VIRGINIA (1975)
James P. Hartnett and Jan L. Saper Apr. 1981 80 p refs
(Grant EPA-R-805588)
(PB82-101478; EPA-600/7-81-066) Avail: NTIS
HC A05/MF A01 CSCL 10A

Energy consumption data for the year 1975 for the states of Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia, as well as for the United States as a whole is presented. Energy use is examined both by consuming sector and by fuel source. The principal components of each sector are described briefly, and detailed comparisons are made among national, six-state, and individual state consumption patterns for 1975. Preliminary estimates are given for total energy consumption in the United States, the six states, and individual states for the years 1976, 1977, and 1978. GRA

N82-18735# Purdue Univ., Lafayette, Ind.
OHIO RIVER BASIN ENERGY STUDY: SOCIAL VALUES AND ENERGY POLICY
Harry R. Potter and Heather J. Norville Apr. 1981 152 p refs Prepared in cooperation with Ohio River Basin Energy Study
(Grants EPA-R-806451; EPA-R-805585)
(PB82-101494; EPA-600/7-81-053) Avail: NTIS
HC A08/MF A01 CSCL 10A

American social values and their relationship to energy production and use within the the Ohio River Basin area are identified and analyzed. The major topics are (1) an overview of social values and energy policy, (2) an identification of values implicit in the Ohio River Basin Energy Study scenarios, (3) a secondary analysis of survey data, and (4) a discussion of variations in social values by social and demographic characteristics. GRA

N82-18736# West Virginia Univ., Morgantown. Bureau of Business Research
AN ECONOMIC ANALYSIS OF THE ELECTRIC UTILITY SECTOR IN THE OHIO RIVER BASIN REGION
Patrick C. Mann and Tom S. Witt Apr. 1981 106 p refs Prepared in cooperation with Ohio River Basin Energy Study
(Grant EPA-R-805585)
(PB82-103268; EPA-600/7-81-047) Avail: NTIS
HC A06/MF A01 CSCL 10A

The potential effects of different pricing mechanisms on capacity requirements, load factors, and fuel costs are discussed, with particular attention paid to their implications for the Ohio River Basin Region. Two sets of estimates for various elasticities of demands are presented. Regulatory policy and its effect upon electricity demand and pricing are studied. GRA

N82-18739# West Virginia Univ., Morgantown. Bureau of Business Research.
ENERGY CONSUMPTION IN THE OHIO RIVER BASIN ENERGY STUDY REGION, 1974, BY END USER AND FUEL TYPE
Walter P. Page Apr. 1981 66 p refs Prepared in cooperation with Ohio River Basin Energy Study
(Grant EPA-R-805585)
(PB82-104811; EPA-600/7-81-048) Avail: NTIS
HC A04/MF A01 CSCL 10A

Energy consumption as of 1974 is calculated for the Ohio River Basin region (substantial parts of Illinois, Indiana, and Ohio, all of Kentucky, most of West Virginia, and southwestern Pennsylvania). Substate energy consumption information is obtained at the Bureau of Economic Analysis (BEA) level and aggregated across BEA areas for an approximation to the Ohio River Basin Energy Study (ORBES) region; a set of factors is applied to allocate partial BEA area energy consumption to the ORBES portion of a given BEA area. Comparisons also are made between regional energy consumption and energy consumption in the six-state area and the United States. GRA

N82-18740# Illinois Univ. at Chicago Circle, Chicago
THE OHIO RIVER BASIN ENERGY FACILITY SITING MODEL. VOLUME 1: METHODOLOGY
Gary L. Fowler, Robert E. Bailey (Ohio State Univ., Columbus), Steven I. Gordon (Ohio State Univ., Columbus), Steven D. Jansen, J. C. Randolph (Indiana Univ., Bloomington), and W. W. Jones (Indiana Univ., Bloomington) Apr. 1981 196 p refs
(Grants EPA-R-805588; EPA-R-805589; EPA-R-805609)
(PB82-102591; EPA-600/7-81-042) Avail: NTIS
HC A09/MF A01 CSCL 10B

The siting model developed for ORBES is specifically designed for regional policy analysis. The region includes 423 counties in an area that consists of all of Kentucky and substantial portions of Illinois, Indiana, Ohio, Pennsylvania, and West Virginia. GRA

N82-18749# National Academy of Sciences - National Research Council, Washington, D. C.
ENERGY AND THE FATE OF ECOSYSTEMS: STUDY OF NUCLEAR AND ALTERNATIVE ENERGY SYSTEMS. SUPPORTING PAPER 8
Oct. 1980 420 p refs
(PB82-113747; ISBN-0-309-03098-6; LC-80-83687) Avail: NTIS HC A18/MF A01 CSCL 06F

The Ecosystem Impacts Resource Group of the Risk and Impact Panel has attempted to identify the unresolved energy policy decisions whose future resolution will have the greatest effect in determining the fate of vulnerable ecosystems, and to assess the likelihood and consequences of undersirable modifications of these systems. GRA

N82-18751# Radian Corp., Austin, Tex.
ENVIRONMENTAL ASSESSMENT, SOURCE TEST AND EVALUATION REPORT: LURGI (KOSOVO) MEDIUM-Btu GASIFICATION Final Report, Mar. 1978 - Mar. 1981
K. W. Lee, W. S. Seames, R. V. Collins, K. J. Bombaugh, and G. C. Page Aug. 1981 325 p refs
(Contracts EPA-68-02-3137; EPA-68-02-2147)
(PB82-114075; EPA-600/7-81-142) Avail: NTIS
HC A14/MF A01 CSCL 13B

An environmental data acquisition program involving a commercial scale, medium Btu, Lurgi gasification plant in the Kosovo region of Yugoslavia is described. The objective of the program was to characterize potential environmental problems associated with coal gasification in a Lurgi plant. The primary conclusion of the environmental assessment mode is that the process exhibits a significant potential for pollution. All discharge streams are potential vehicles for pollutant transfer from the process to the environment. The streams with the highest priority for control based on their potential for adverse health effects in the three discharge media, are the H2S rich waste gas, phenolic wastewater, and heavy tar. GRA

N82-18753# TRW, Inc., Redondo Beach, Calif. Environmental Engineering Div.
EMISSIONS ASSESSMENT OF CONVENTIONAL STATIONARY COMBUSTION SYSTEMS: SUMMARY REPORT Final Report, Sep. 1976 - Jul. 1981
C. C. Shih and A. M. Takata Sep. 1981 77 p refs
(Contract EPA-68-02-2197)
(PB82-109414; EPA-600/7-81-003D) Avail: NTIS
HC A05/MF A01 CSCL 13B

Results of a characterization of multi-media emissions from 39 source categories of conventional stationary combustion systems are reported. In the assessment, existing emissions data were first examined to determine the adequacy of the data base. This was followed by a measurement program to fill identified data gaps. Emissions data obtained from the sampling and analysis program were combined with existing emissions data to provide estimates of emission levels, and to define the need for additional data. Study results indicate that flue gas emissions of NOx, SO2, and particulate matter from the 39 source categories account for approximately 86, 66, and 36%, respectively, of the emissions of these pollutants from all stationary sources. Additionally, flue gas emissions of sulfates and several trace elements from coal- and oil-fired combustion sources also require further attention. GRA

N82-18757# Scott Environmental Technology, Inc., San Bernardino, Calif.

INVENTORY OF EMISSIONS FROM MARINE OPERATIONS WITHIN THE CALIFORNIA COASTAL WATERS Final Report

W. C. Kelly, L. R. Reckner, and G. D. Maines 26 Jun. 1981 222 p refs
(Contract ARB-A5-209-30)
(PB82-105099; Rept-2581-01-0881; ARB-R-81/40) Avail: NTIS HC A10/MF A01 CSCL 13B

The magnitude of air polluting emissions from marine vessels and marine related activities in the coastal waters and ports of California is studied. Major sources of emissions included the operation of marine engines and auxiliary power plants; the transport, handling, storage and transfer of petroleum and petroleum products, and the ballasting and lightering associated with tanker vessel operations. The record of activity of every commercial vessel operating in the waters of California was traced and the emissions were calculated for each activity of these vessels. The average daily emissions were - NOx 41.4 tons per day (tpd), CO 8.3 tpd, SO2 79.2 tpd, hydrocarbons 21.5 tpd, and particulates 7.6 tpd. GRA

N82-18768# PEDCo-Environmental, Inc., Cincinnati, Ohio.
EPA UTILITY FGD (FLUE GAS DESULFURIZATION) SURVEY Final Report, Apr. - Jun. 1981

M. Smith, M. Melia, N. Gregory, and R. McKibben Aug. 1981 335 p
(Contract EPA-68-02-3173)
(PB82-115858; EPA-600/7-81-012D) Avail: NTIS HC A15/MF A01 CSCL 13B

A survey of operational and planned domestic utility flue gas desulfurization (FGD) systems, operational domestic particle scrubbers, and Japanese coal-fired utility FGD installations is presented. It summarizes information contributed by the utility industry, system and equipment suppliers, systems designers, research organizations and regulatory agencies. It presents data on system design, fuel characteristics, operating history, and actual performance. Unit by unit dependability parameters are included and problems and solutions associated with the boilers, scrubbers, and FGD systems are discussed. The domestic FDG systems are tabulated alphabetically by development status (operational, under construction, or in the planning stages), utility company, system supplier, process, waste disposal practice, and regulatory class. Author

N82-19103*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Technology Utilization Office.
NASA TECHNOLOGY UTILIZATION HOUSE TECHNICAL SUPPORT PACKAGE SUMMARY OF RESULTS AND HOUSE DESCRIPTION Final Report

Aug. 1979 83 p
(NASA-TM-X-74686) Avail: NTIS HC A05/MF A01 CSCL 13M

The Technology Utilization House (Tech House) was designed and constructed to demonstrate to the building industry and the public the benefits of aerospace technology and other new technology that are presently available or will be in very near future. Use of solar energy, conservation of energy and of water, safety, and security were incorporated in the design of the house. The terms to be incorporated into the house and to assist in the design of the house were evaluated. An architectural engineering team was employed to investigate energy conservation ideas, determine cost effectiveness of new materials and systems, and prepare specifications and drawings for the house. The Tech House was constructed during the spring of 1976. All the systems were monitored to insure proper operation, and data were collected during a one year occupancy. Results obtained during the family live-in period, comments on the acceptance of the various energy-saving systems by the family, and suggestions for improvement of the systems are presented. N.W.

N82-19108# International New Towns Association, Hague (Netherlands).
FOURTH ANNUAL COMMUNITY PLANNING AND DEVELOPMENT CHALLENGES: ENERGY, ENVIRONMENT, WATER

Columbia, S.C. Mar. 1981 95 p refs Proceedings of Conf. held in Cairo, 3-14 Oct. 1980
(Grant HUD-H-5371RG)
(PB82-125790; HUD-0002055) Avail: NTIS HC A05/MF A01 CSCL 13B

The Egyptian government's commitment to a massive new towns program was noted. Free standing new towns, solely dependent upon employment growth, were discussed. National energy conservation policies were seen as effective only through price mechanisms. Research and development programs on new technologies were considered more effective on smaller rather than larger scales. Governments were seen as not facing up to the political problems of rapid urbanization. The capacity of the infrastructure of existing cities was seen as not keeping up with growing demand in developing countries. GRA

N82-19398# Bureau of Reclamation, Boulder City, Nev.
WATER ASSESSMENT FOR THE LOWER COLORADO RIVER REGION-EMERGING ENERGY TECHNOLOGY DEVELOPMENT

Aug. 1981 170 p Sponsored in part by Water Resources Council
(PB82-110107) Avail: NTIS HC A08/MF A01 CSCL 13B

Water supply availability for two hypothetical levels of emerging energy technology development are assessed. The water and related land resources implications of such hypothetical developments are evaluated. Water requirement, the effects on water quality, costs of water supplies, costs of disposal of wastewaters, and the environmental, economic and social impacts are determined, providing information for the development of non-nuclear energy research. GRA

N82-19542*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONVENTIONAL ENGINE TECHNOLOGY. VOLUME 1: STATUS OF OTTO CYCLE ENGINE TECHNOLOGY

M. W. Dowdy 15 Dec. 1981 216 p refs
(Contracts NAS7-100; DE-AI01-80CS-50194)
(NASA-CR-168643; JPL-Pub-81-65-Vol-1; DOE/CS-50194/1)
Avail: NTIS HC A10/MF A01 CSCL 21A

Federally-mandated emissions standards have led to major changes in automotive technology during the last decade. Efforts to satisfy the new standards were directed more toward the use of add-on devices, such as catalytic converters, turbochargers, and improved fuel metering, than toward complete engine redesign. The resulting changes are described and the improvement brought about by them in fuel economy and emissions levels are fully documented. Four specific categories of gasoline-powered internal combustion engines are covered, including subsystem and total engine development. Also included are the results of fuel economy and exhaust emissions tests performed on representative vehicles from each category. Author

N82-19543*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONVENTIONAL ENGINE TECHNOLOGY. VOLUME 2: STATUS OF DIESEL ENGINE TECHNOLOGY

H. W. Schneider 15 Dec. 1981 191 p refs
(Contracts NAS7-100; DE-AI01-80CS-50194)
(NASA-CR-168644; JPL-Pub-81-65-Vol-2; DOE/CS-50194/1)
Avail: NTIS HC A09/MF A01 CSCL 21A

The engines of diesel cars marketed in the United States were examined. Prominent design features, performance characteristics, fuel economy and emissions data were compared. Specific problems, in particular those of NO and smoke emissions, the effects of increasing dieselization on diesel fuel price and availability, current R&D work and advanced diesel concepts are discussed. Diesel cars currently have a fuel economy advantage over gasoline engine powered cars. Diesel drawbacks (noise and odor) were reduced to a less objectionable level. An equivalent gasoline engine driveability was obtained with turbocharging. Diesel manufacturers see a growth in the diesel market for the next ten years. Uncertainties regarding future emission regulation may inhibit future diesel production investments. With spark ignition engine technology advancing in the direction of high compression ratios, the fuel economy advantages of the diesel car is expected to diminish. To return its fuel economy lead, the diesel's potential for future improvement must be used. Author

N82-19544*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONVENTIONAL ENGINE TECHNOLOGY. VOLUME 3: COMPARISONS AND FUTURE POTENTIAL

M. W. Dowdy 15 Dec. 1981 32 p ref
(Contracts NAS7-100; DE-AI01-80CS-50194)
(NASA-CR-168645; JPL-Pub-81-Vol-3; DOE/CS-50194/1)
Avail: NTIS HC A03/MF A01 CSCL 21A

The status of five conventional automobile engine technologies was assessed and the future potential for increasing fuel economy and reducing exhaust emission was discussed, using the 1980 EPA California emisions standards as a comparative basis. By 1986, the fuel economy of a uniform charge Otto engine with a three-way catalyst is expected to increase 10%, while vehicles with lean burn (fast burn) engines should show a 20% fuel economy increase. Although vehicles with stratified-charge engines and rotary engines are expected to improve, their fuel economy will remain inferior to the other engine types. When adequate NO emissions control methods are implemented to meet the EPA requirements, vehicles with prechamber diesel engines are expected to yield a fuel economy advantage of about 15%. While successful introduction of direct injection diesel engine technology will provide a fuel savings of 30 to 35%, the planned regulation of exhaust particulates could seriously hinder this technology, because it is expected that only the smallest diesel engine vehicles could meet the proposed particulate requirements. A.R.H.

N82-19660# Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
SOCIAL AND ENVIRONMENTAL CONSEQUENCES OF NATURAL RESOURCES POLICIES WITH SPECIAL EMPHASIS ON BIOSPHERE RESERVES Final General Technical Report
Peter F. Ffolliott (Arizona Univ., Tucson) and Gonzalo Halffter (Inst. of Ecology, Mexico) 22 Sep. 1981 63 p refs Seminar held at Durango, Mexico, 8-13 Apr. 1980
(PB82-113937; FSGTR/RM-88) Avail: NTIS HC A04/MF A01 CSCL 02F

A seminar to promote international cooperation among natural resources policy makers, scientists, and educators, within the framework of the international Man and the Biosphere Program is discussed. Papers on a variety of topics relating to natural resources policies formed a basis for formal and information discussions among the participants proceedings are discussed. GRA

N82-19664 Department of Energy, London (England). Transport Working Group.
REVIEW OF THE UK TRANSPORT ENERGY OUTLOOK: AND POLICY RECOMMENDATIONS
1981 43 p refs
(EP-47; ACEC-Paper-11) Copyright. Avail: Issuing Activity; HMSO £4 + postage, PHI

Liquid fuel consumption for transport (excluding international bunkers for ships) in 1979 is analyzed and used to forecast the position at the end of the century. Car population is expected to increase by 6 million to over 20 million, but fuel saving designs mean that fuel consumption increases only slightly. Truck fuel consumption stays the same. Fuel consumption by UK airlines is expected to double. The proportion of a barrel of crude oil which is refined as transport fuel must be increased. Author (ESA)

N82-19665 Department of Energy, London (England). Buildings Working Group.
ENERGY CONSERVATION IN THE PRODUCTION OF DOMESTIC HOT WATER
1981 23 p refs
(EP-48; ACEC-Paper-12) Copyright. Avail: Issuing Activity; HMSO £2.80 + postage, PHI

Improvements in energy efficiency in existing buildings and the construction of energy efficient buildings are discussed with emphasis on water heating. Cost effective measures proposed include fitting an 80-mm insulating jacket to the hot water storage cylinder, using time switches, fitting thermostatic control systems to boiler based central heating, and storing domestic hot water at a lower temperature. Research into the recovery of heat from waste water, the use of cold water detergents, and the use of heat pumps is urged. Author (ESA)

N82-19666 Department of Energy, London (England). Severn Barrage Committee.
TIDAL POWER FROM THE SEVERN ESTUARY, VOLUME 1
1981 125 p refs Original contains color illustrations 2 Vol.
(EP-46 Vol-1; ISBN-0-11-410916-8) Copyright. Avail: Issuing Activity; HMSO £9.80 + postage, PHI

Environmental, energy, and economic factors associated with building a tidal power barrage in the Bristol channel were studied. An ebb generation scheme is recommended since it minimizes the unit cost of electricity generation and has less effect on ports than flood or two way generation. The economic justification for a barrage depends on factors which are not known when the decision on whether to build is taken, e.g., the extent of nuclear generation, or the price of coal in the first third of the next century. Further study of the environmental consequences of the barrage is required. An inner barrage is recommended since the larger output of an outer barrage does not outweigh engineering, environmental and economic disadvantages. Author (ESA)

N82-19697# Commerce Dept., Washington, D.C. Economic Policy Staff.
US ENERGY FOR THE REST OF THE CENTURY Annual Report
Joseph F. Gustaferro 2 Jul. 1981 36 p
(PB82-115866) Avail: NTIS HC A03/MF A01 CSCL 10A

The basic quantitative results of U.S. Commerce Department forecasting efforts in the energy area are summarized. The data cover the entire spectrum of U.S. energy requirements and focus on the end-use of energy for operational purposes, e.g. highway transportation, space heating, lighting, and road construction. The tables provide data on fuel consumption by types and BTU content for 1980 and as projected for the year 2000. GRA

N82-19701 International Institute for Applied Systems Analysis, Laxenburg (Austria).
LIFE ON A WARMER EARTH: POSSIBLE CLIMATIC CONSEQUENCES OF MAN MADE GLOBAL WARMING
H. Flohn 1981 80 p refs
(ER-3) Copyright. Avail: Issuing Activity

The interaction between energy and climate is explored, including the impact on global climate of three main energy sources: solar, nuclear and fossil fuels. The global warming problem is introduced. Comprehensive analogies with warmer times are made. From the best models available, the future global average surface temperature is found and modified, describing the global warming effects caused by greenhouse effect caused by gases other than carbon dioxide, released into the atmosphere by man, i.e. nitrous oxide, methane, ammonia, and the chlorofluoromethanes. Paleoclimatic scenarios are reviewed, showing possible effects of global warming. An 800 to 1100 ppm CO_2 concentration causes irreversible Arctic melting, leading to displacement of present climatic zones by 400 to 800 km. Author (ESA)

N82-19704# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PRELIMINARY RESULTS OF A STUDY OF MAPPING THERMAL DISCHARGE IN THE OCEAN, USING REMOTE SENSING DATA
Merritt Raymond Stevenson, Carlos Alberto Steffen, and Hector Manual Inostroza Villagra Sep. 1981 23 p refs In PORTUGUESE; ENGLISH summary Presented at 33d Ann. Meeting of SBPC, Salvador, 8-15 Jul. 1981
(INPE-2229-PRE/021) Avail: NTIS HC A02/MF A01

The spatial and temporal variations of the sea surface temperature, utilizing data obtained from sea surface, aircraft and satellite platforms were studied. The objective of the study is the evaluation and mapping of small scale variations in the sea surface temperature, caused by the thermal discharge from a nuclear power plant at Angra dos Reis, Brazil. Evaluation of data from ANGRA 01, the first experiment made on December 19, 1980, showed the surface temperature to be quite isothermal. Temperature from the aircraft and satellite radiometers were about 0.6 C and 5.0 C cooler, respectively, than the temperatures measured from the boat. These thermal offsets are readily accounted for by differences in emissivities of the sea surface and the intervening water vapor in the lower atmosphere. Author

N82-20025# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
URBAN TRAFFIC SIGNAL CONTROL FOR FUEL ECONOMY. PART 2: EXTENSION TO SMALL CARS

G. S. Messenger Nov. 1981 13 p refs
(AD-A109393; DME-ME-249; NRC-19846) Avail: NTIS HC A02/MF A01 CSCL 13/6

Use of a small car's characteristics in a simulation program utilizing velocity profiles obtained in a traffic study by the Metropolitan Toronto Roads and Traffic Department and the Engine Laboratory at the National Research Council Canada has shown that trends shown in fuel consumption in NRC, Division of Mechanical Engineering Report No. ME-247 are similar for a small-engined vehicle. NRC, DME Report No. ME-247 showed that under the TRANSYT timing plan vehicles encountered fewer stops, saved time and used a slightly smaller amount of fuel than under the existing timing plan. In the above mentioned report, a large vehicle's fuel consumption was calculated using a computer model of the vehicle which used velocity profiles obtained from an instrumented floating car. GRA

N82-20027# Market Facts, Inc., Arlington, Va. Public Sector Research Group.
CONSUMER BEHAVIOR TOWARDS FUEL EFFICIENT VEHICLES. VOLUME 1: EXECUTIVE SUMMARY Final Report Oct. 1977 - Mar. 1981
James T. Heisler and Sid Groeneman Mar. 1981 22 p
(Contract DOT-HS-7-01781)
(PB82-103300; DOT-HS-805936) Avail: NTIS HC A02/MF A01 CSCL 10A

Information on likely market response to various vehicle design and performance collected to minimize the possibility of market rejection is discussed. Group discussion and consumer experiments with drivers in different vehicle size classes were used. Analysis focuses on the believability of the energy crisis and concern about its effects, the acceptability of possible fuel economy options, consumer preference with respect to vehicles embodying selected design and engineering changes, and predicted purchase and usage patterns under different future scenarios. GRA

N82-20277# Physical Sciences, Inc., Woburn, Mass.
SYNTHETIC-FUEL COMBUSTION: POLLUTANT FORMATION. SOOT-INITIATION MECHANISMS IN BURING AROMATICS Fourth Quarterly Report, 1 Jul. - 30 Sep. 1981
W. T. Rawlins, S. P. Schertzer, and T. Tanzawa Nov. 1981 43 p refs
(Contract DE-AC22-80PC-30292)
(DE82-002566; DOE/PC-30292/4; PSI-TR-291) Avail: NTIS HC A03/MF A01

The pyroiysis rates, free radical kinetics, and soot and NO/sub x/ formation mechanisms for a variety of aromatic families such as those of benzene, anisole, phenol, and nitrogen heterocyclics were examined. The processes are studied in shock tubes, where combustion temperatures is attained almost instantly without wall effects and under well controlled flow conditions. Experiments are performed in incident shock waves, using optical absorption and emission diagnostics in the ultraviolet, visible, and infrared. It is indicated that soot formation is minimal for pyridine and proceeds rapidly for toluene, and a bimodal mechanism above 2000 K is shown. Comparison of ultraviolet and visible attenuation signals indicates that the mean size of the soot particles causing the attenuation is considerably larger than previously assumed, and requires the use of complete Mie theory rather than the Rayleigh limit in data interpretation. DOE

N82-20328# Committee on Governmental Affairs (U. S. Senate).
INTERNATIONAL ALCOHOL FUELS
Washington GPO 1981 383 p Hearing before the Subcomm. on Energy, Nuclear Proliferation, and Govt. Processes of the Comm. on Governmental Affairs, 97th Congr., 1st Sess., 24 Mar. 1981
(GPO-78-681) Avail: Subcomm. on Energy Nuclear Proliferation, and Govt. Processes

The production of alcohol fuels and other nonpetroleum-based liquid fuels is discussed in the context of problems caused by U.S. dependence upon imported petroleum fuels. Biomass energy production and coal liquefaction are considered. Gasohol production and utilization are emphasized. Economic factors influencing private investments in alternative energy enterprises are discussed. The impact of increased alcohol fuel production on agriculture is considered. R.J.F.

N82-20329# Committee on Science and Technology (U. S. House).
THE NATURAL GAS OPTION: NEW RESOURCES AND NEW TECHNOLOGIES
Washington GPO 1981 176 p Hearing before the Subcomm. on Energy Development and Applications of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., No. 28, 22 Jul. 1981
(GPO-85-052) Avail: Subcomm. on Energy Development and Applications

The ability of the gas industry to develop new technology for gas production and efficient gas use is examined. Synfuel/ production coal gasification, coal liquefaction, and other alternative fuel technologies are discussed. The gas energy supply outlook for 1980 to 2000 is discussed. R.J.F.

N82-20359# Long Island Appropriate Technology Group, Wantagh, N.Y.
RESIDENTIAL HEATING AND ENERGY CONSERVATION STUDY, NORTHPORT, NEW YORK. PHASE 1: CITIZEN'S HANDBOOK Progress Report, 1 Jan. - 31 Mar. 1978
Clarence N. Freeman Mar. 1978 65 p refs 2 Vol.
(Grant NSF OSS-77-23950)
(PB82-100454; NSF/RA-780905) Avail: NTIS HC A04/MF A01 CSCL 13A

Subjects on home energy conservation are presented in nontechnical terms. Topics include the behavior of heat and heat exchangers; human comfort; home heating; development of a home heating and maintenance manual; infiltration of cold air; sources of combustion air; dangers of a house which is too airtight; operation of the home during the heating season; condensation problems resulting from re-insulation; heating system maintenance; and possible improvements in hot air, hot water, and steam, gas-fired or oil-fired heating systems. Heat conservation through changing living patterns and rearranging furniture is also discussed. References are provided on the topics of energy conservation, home weatherizing, residential construction, heating systems, emergency situations, weather, and climate. GRA

N82-20360# Long Island Appropriate Technology Group, Wantagh, N.Y.
RESIDENTIAL HEATING AND ENERGY CONSERVATION STUDY, NORTHPORT, NEW YORK. PHASE 2: CITIZEN'S HANDBOOK Progress Report, 1 Oct. - 31 Dec. 1978
Clarence N. Freeman 1978 68 p refs 2 Vol.
(Contract NSF OSS-77-23950)
(PB82-100462; NSF/RA-780906) Avail: NTIS HC A04/MF A01 CSCL 13A

Energy conservation, energy laws of New York State and the United States Government, energy audits in the home, and tax credits are discussed. The behavior of heat and heat exchangers; energy conservation upgrading of the home; methods of taking advantage of heating effects of the Sun; and improving air circulation are discussed. Supplementary energy conservation topics, including a discussion of gas savings resulting from lowering thermostats at night, and a description of an air deflector for baseboard heaters are discussed. Lists of references cover general energy conservation, heat behavior and human comfort, home weatherization, residential construction, heating systems, emergency home heating, and carbon monoxide poisoning from blocked furnace flues. References on climate and degree days are also listed. GRA

N82-20475# Bonneville Power Administration, Portland, Oreg. Mechanical Section.
HEAT PUMP WATER HEATER: MIDWAY RESIDENTIAL COMMUNITY Final Report
J. R. Aguilar and Jon R. Biemer Oct. 1981 63 p refs Sponsored by DOE
(DE82-003548; DOE/BP-53) Avail: NTIS HC A04/MF A01

A prototype heat pump water heater was tested. Five heat pump water heaters were installed in a residential community at Midway, Washington, and their performance was monitored between September 1979 and January 1981. The objectives of the project were to evaluate performance, to assess equipment reliability, and to determine energy savings. Results were also used to assess the heat pump water heater's potential contribution to energy conservation in the Pacific Northwest. The coefficient of performance (COP) and energy savings compared to an electric resistance water heater are 1.66 and 40%, respectively. Because the COP of a heat pump water heater varies with the ambient temperature, performance of a unit affected by seasonal and climatic variation. The energy savings of individual heat pump

water heaters will vary from 41 to 56% in the Pacific Northwest, depending on climatic conditions. DOE

N82-20476# United Technologies Research Center, East Hartford, Conn.
PARAMETRIC PERFORMANCE STUDIES ON FLUIDIZED-BED HEAT EXCHANGERS Quarterly Technical Progress Report, 28 Jul. - 30 Sep. 1981
R. C. Stoffler 29 Oct. 1981 9 p refs
(Contract DE-AC22-81PC-40280)
(DE82-002124; DOE/PC-40280/T1; R81-915729-3) Avail: NTIS HC A02/MF A01

The performance of single and multistage shallow fluidized beds for possible application to the recovery of heat from sources as waste heat, and coal combustion or coal gasification were investigated. The following tests are investigated: (1) the effects of fouling due to liquid condensate in the gas stream of fluidized beds which are staged using baffle plates; and (3) the effects of different heat exchanger surface geometries. The conditions fouling by a liquid condensate are selected. Modifications are made to the fluidized bed heat exchanger facility for the fouling experiments. DOE

N82-20616# Committee on Energy and Natural Resources (U.S. Senate).
PROPOSED 5-YEAR PLAN OIL AND GAS DEVELOPMENT IN THE OUTER CONTINENTAL SHELF
Washington GPO 1981 170 p refs Hearing before the Subcomm. on Energy Conservation and Supply of the Comm. on Energy and Natural Resources, 97th Congr., 1st Sess., 6 Oct. 1981
(Publ-97-43; GPO-86-955) Avail: Subcomm. on Energy Conservation and Supply

A proposed 5-year plan for offshore oil and gas exploration and development is discussed. The program calls for 42 lease sales covering nearly 1 billion acres. Whether the proposed lease sales could be detrimental to the protection of environmentally sensitive areas and fishing ground is discussed. Oil spills and transport problems are investigated. R.J.F.

N82-20658# Committee on Energy and Natural Resources (U.S. Senate).
POTENTIAL FOR HYDROELECTRIC DEVELOPMENT IN ALASKA
Washington GPO 1981 64 p Hearing before the Subcomm. on Water and Power of the Comm. on Energy and Nat. Resources, 97th Congr., 1st Sess., 17 Aug. 1981
(GPO-84-559; Publ-97-31) Avail: Subcommittee on Water and Power

Testimony concerning Alaskan hydroelectricity development is presented. Various public and private organizations were represented. N.W.

N82-20659# Committee on Energy and Natural Resources (U.S. Senate).
HYDROELECTRIC DEVELOPMENT IN NEW ENGLAND
Washington GPO 1981 233 p Hearing before the Subcomm. on Energy Regulation of the Comm. on Energy and Natural Resources, 97th Congr., 1st Sess., 7 Aug. 1981
(GPO-84-558; Publ-97-40) Avail: Subcomm. on Energy Regulation

Hydroelectric power development in New England is examined and the Federal licensing process is presented from different perspectives. State officials, hydrodevelopers, conservation and recreation interests, and power marketers are represented. S.L.

N82-20660# Committee on Energy and Natural Resources (U.S. Senate).
OCEAN THERMAL ENERGY CONVERSION RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT
Washington GPO 1980 124 p Hearing on S. 1830 before the Subcomm. on Energy Res. and Development of the Comm. on Energy and Natural Resources, 96th Congr., 1st Sess., 15 Oct. 1979
(GPO-56-801; Publ-96-77) Avail: Subcomm. on Energy Res. and Development

A research, development, demonstration, and commercialization program in ocean thermal energy conversion is presented. A national commercialization goal is established an preparation of a plan to accomplish is addressed. S.L.

N82-20666# Committee on Science and Technology (U. S House).
ENERGY DEMAND FORECASTING
Washington GPO 1981 366 p Hearings before the Subcomm. on Investigations and Oversight of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., No. 14, 1-2 Jun. 1981
(GPO-83-115) Avail: Subcomm. on Investigations and Oversight

Energy demand forecasting and its connection with national energy policies and decisions is examined in light of recent, sharply revised estimates of future energy requirements. Techniques of economic projects are examined. Modeling of energy demands is discussed. Renewable energy sources are discussed. The shift away from reliance of domestic users on oil and natural gas toward electricity as a primary energy resource is examined in the context of the need to conserve energy and expand generating capacity in order to avoid a significant electricity shortfall. R.J.F.

N82-20679# Kaiser Engineers, Oakland, Calif.
INDUSTRIAL UTILIZATION OF WASTE-DERIVED ENERGY. VOLUME 2: APPENDICES 1 AND 2
Sep. 1981 201 p refs
(Contract DE-AC03-78CS-20030)
(DE82-003287; DOE/CS-20030/2) Avail: NTIS HC A10/MF A01

The economic and technical feasibility of producing medium Btu fuel gas in a partial oxidation unit (Purox System) from a combination of both rural and urban wastes was determined. Institutional aspects, a review of alternative technologies and a program recommendation are presented. DOE

N82-20690# Environmental Protection Agency, Ann Arbor, Mich. Standards Development and Support Branch.
AN ENERGY DEMAND MODEL FOR LIGHT-DUTY VEHICLES, WITH CONCEPTS FOR ESTIMATING FUEL CONSUMPTION
Terry Newell Apr. 1981 34 p refs
(PB82-102468; EPA-AA-SDSB-81-2) Avail: NTIS HC A03/MF A01 CSCL 10A

The development of the energy demand modeling program, the use of the program, and the verification of using the energy demand concept to estimate vehicle fuel consumption are described. In addition, several applications of the model are presented and other potential applications are discussed. GRA

N82-20693# California Univ., Irvine. Sanitary Engineering and Environmental Health Research Lab.
ENVIRONMENTAL QUALITY RESEARCH-FATE OF TOXIC JET FUEL COMPONENTS IN AQUATIC SYSTEMS Annual Report, 1 Jun. 1980 - 31 May 1981
Robert C. Cooper, Leon Hunter, P. C. Ulrichs, and Robert Okazaki Wright-Patterson AFB, Ohio Air Force Aerospace Medical Research Lab. Dec. 1981 61 p refs
(Contract F33615-80-C-0512; AF Proj. 6302)
(AD-A109790; AFAMRL-TR-81-101) Avail: NTIS HC A04/MF A01 CSCL 06/2

This report contains the results of an investigation of the potential toxic effects of the jet fuel JP-4 (petroleum-based and shale-based) on the aqueous environment. Composition of different JP-4 samples and their water extracts are compared. Techniques for the formation and analysis of water soluble extracts of JP-4 are described together with preliminary bioassay procedures using the aquatic organisms, Daphnia magna and Artemia salina. The first steps in the development of a mathematical model designed to describe and predict the effects of jet fuel spills are reported. Author (GRA)

N82-20699# State Univ. of New York, Stony Brook. Marine Sciences Research Center.
COAL WASTE ARTIFICIAL REEF PROGRAM, PHASE 3. VOLUME 1: SUMMARY REPORT Interim Report, Oct. 1981
J. H. Parker, P. M. J. Woodhead, I. W. Duedall, and H. R. Carleton Oct. 1981 79 p refs Sponsored by Electric Power Research Institute
(EPRI Proj. 1341-1)
(DE82-900854; EPRI-CS-2009-Vol-1) Avail: NTIS HC A05/MF A01

The technical feasibility and the environmental effects of a method for ocean disposal of fly ash and scrubber sludge were

explored. Techniques were developed for coal waste block fabrication utilizing machines and equipment from the concrete block industry. Accelerated steam curing procedures developed block strengths adequate for industrial handling and stacking. The new fabrication techniques were successfully established at commercial block factories and 450 metric tons (500 short tons) of stabilized wastes were processed into about 15,000 reef-blocks. Two waste materials were used with fly ash to sludge ratios of 4:1 and 1.5:1 respectively. Small numbers of blocks were made separately from fluidized bed combustion residues. In laboratory bioassays and in field tests, the material did not appear to be toxic in the sea. These results all suggested that the blocks are compatible with the marine environment. T.M.

N82-20700# General Electric Co., Schenectady, N. Y.
ELECTROCYCLONE DEVELOPMENT PROGRAM Quarterly Technical Report, Feb. - Apr. 1981
1981 43 p
(Contract DE-AC21-80ET-17091)
(DE81-025062; DOE/ET-17091/T2; FE-7091-10) Avail: NTIS HC A03/MF A01

In response to the need for a high efficiency, high throughput gas cleanup device for pressurized fluidized bed application, General Electric experimented with an elecrostatically augmented cyclone. A principal advantage of the GE Electrocyclone concept is that a 12 ft dia unit can be built with performance comparable to a 10 in conventional cyclone. The use of large Electrocyclones will avoid the plugging and flow imbalance problems which plagued the use of multiclones. The development work is being continued under the present Electrocyclone Development Program. The Electrocyclone Development Program addresses three critical development areas: performance scaleup; performance at high temperature and pressure; and corona charging. The scaleup of Electrocyclone performance will be demonstrated experimentally by cold flow testing of a 36 in-dia unit geometrically similar to the earlier 18-in model. DOE

N82-20701# Hoffman-Holt, Inc., Silver Spring, Md.
ENVIRONMENTAL AND ECONOMIC ASPECTS OF INDIRECT COAL LIQUEFACTION PROCESSES: A REPORT EMPHASIZING THE RELATIONSHIP BETWEEN PRODUCT MIX AND EFFICIENCY
Lawrence Hoffman Sep. 1981 40 p refs
(Contract EPA-68-02-3671)
(PB82-103581; EPA-600/7-81-153) Avail: NTIS HC A03/MF A01 CSCL 07A

Environmental and economic aspects of three indirect liquefaction processes are reported. The following are addressed: U.S. coal resources; indirect coal liquefaction processes; and environmental and economic aspects associated with the considered processes. The conservation of coal resources would be affected by conversion efficiencies, which vary with process and product mix. For the processes considered, for similar liquid to gas ratio values (product mix), the coal to methanol is the most efficient while the Fischer Tropsch is the least efficient. For these processes, the cost per Btu of product at reasonable equivalent liquid/gas ratios is greatest for Fischer Tropsch and the least for the coal to methanol process. GRA

N82-20702# Wyoming Game and Fish Dept., Cheyenne.
WETLAND VEGETATION, ENVIRONMENTAL FACTORS, AND THEIR INTERACTION IN STRIP MINE PONDS, STOCKDAMS, AND NATURAL WETLANDS Final Forest Service General Technical Report
Richard A. Olson Ft. Collins, Colo. Rocky Mountain Forest and Range Experiment Station 21 Sep. 1981 25 p refs
(PB82-113218; FSGTR/RM-85) Avail: NTIS HC A02/MF A01 CSCL 06F

Water regime, chemical features, temperature factors, light penetration, substrate properties, and physical characteristics are described for Northern Great Plains strip mine ponds and stockdams, followed by a discussion of how their interaction determines wetland plant community composition and resulting wildlife habitat quality for consumptive and nonconsumptive resource utilization. GRA

N82-21208# Rolls-Royce Ltd., Derby (England).
ENGINES FOR AIR TRANSPORT
A. G. Newton 1981 52 p
(PNR-90068) Avail: NTIS HC A04/MF A01

The status and trends of commercial aircraft transportation systems were reviewed. The characteristics and specific consumption of aviation fuel are emphasized. It is shown that in the next 15 years the fuel consumption of current large fan engines can be reduced by 15%. The quality of fuel will deteriorate relative to today, which will place greater demands on engine design. Further improvements in fuel economy using engines designed for lower specific thrust appear feasible. The development of a full authority digital control system and its effects on fuel consumption are also discussed. Author (ESA)

N82-21350# Environmental Protection Agency, Ann Arbor, Mich. Test and Evaluation Branch.
TESTING OF 6 ENGINE OILS IN ACCORDANCE WITH THE EPA RECOMMENDED PRACTICE FOR TESTING, GRADING AND LABELING THE FUEL EFFICIENCY OF MOTOR VEHICLE ENGINE OILS
F. Peter Hutchins and Thomas J. Penninga May 1981 97 p
(PB81-244980; EPA-AA-TEB-81-16) Avail: NTIS HC A05/MF A01 CSCL 07H

In January/February 1980, the EPA assembled the 'EPA Recommended Practice for Evaluating, Grading and Labeling the Fuel Efficiency of Motor Vehicle Engine Oils'. This procedure used the ASTM approach for carryover oils and incorporated four fuel economy grades for engine oils as well as a label for identification. In March 1980, the EPA initiated a testing program in accordance with the EPA recommended procedure, using two sets of test vehicles to evaluate the feasibility of the procedure. The results of that testing are covered. GRA

N82-21448# California Energy Commission, Sacramento.
ENERGY BUILDING REGULATIONS FOR NEW RESIDENTIAL AND NONRESIDENTIAL BUILDINGS
15 Jul. 1981 73 p refs
(PB82-117813; CAEC-400-81-005) Avail: NTIS HC A04/MF A01 CSCL 13L

The proposed regulations as submitted to the State Building Standards Commission of California are presented. They are divided into four parts: applying to all occupancies; technical regulations; technical regulations applicable for ducts only; and table of contents of existing building regulations which identifies which sections will be repealed when the new regulations take effect. GRA

N82-21728# Energy Information Administration, Washington, D.C. Statistics Branch.
STATE ENERGY DATA REPORT SUPPLEMENT
27 Oct. 1981 73 p
(DE82-002996; DOE/EIA-0214/79-S) Avail: NTIS HC A04/MF A01

Selected summaries and percent changes of energy consumption by state, by principal energal sources, and by major end-use sectors are presented. DOE

N82-21760# Oak Ridge Associated Universities, Inc., Washington, D.C.
CENTER FOR ENERGY RESEARCH AND TECHNOLOGICAL RESOURCES FOR PUERTO RICO Ph.D. Thesis - Univ. de Puerto Rico
Petro A. MunizRivera 1981 184 p refs In SPANISH and ENGLISH
(Contract DE-AC05-76OR-00033)
(DE81-031987; DOE/TIC-11493) Avail: NTIS HC A09/MF A01

The design of an energy-efficient building is presented. Justification for the building is explained. Technical aspects of passive solar design and policies dealing with solar design are described. The layout of the building, and functions and uses of various areas of the building are detailed. DOE

N82-21770# Resource Planning Associates, Inc., Washington, D.C.
CONSUMPTION TREND ANALYSIS IN THE INDUSTRIAL SECTOR: EXISTING FORECASTS Final Report, Nov. 1980 - Aug. 1981
Aug. 1981 72 p
(Contract GRI-5014-310-0238)
(PB82-137829; GRI-80/0090; RPA-RA-80-0429-3) Avail: NTIS HC A04/MF A01 CSCL 10A

The Gas Research Institute (GRI) is engaged in medium- to

long-range research and development in various sectors of the economy that depend on gasing technologies and equipment. To assess the potential demand for natural gas in the industrial sector, forecasts available from private and public sources were compared and analyzed. More than 20 projections were examined, and 10 of the most appropriate long-range demand forecasts were analyzed and compared with respect to the various assumptions, methodologies and criteria on which each was based. GRA

N82-21781# California Univ., Livermore. Lawrence Livermore Lab.
SEDIMENTATION PLAN TO ASSESS THE IMPACT GEOTHERMAL ACTIVITIES TO THE AQUATIC ECOSYSTEM IN THE GEYERS CALISTOGA KGRA
Robert R. Ireland 19 May 1981 45 p
(Contract W-7405-eng-48)
(DE82-001688; UCID-19059) Avail: NTIS HC A03/MF A01

The prevention of sedimentation or siltation in aquatic ecosystems is always a key enviromental issue in the development and operation of power plant units. A field program, which will assess the amount of sedimentation in the streams and tributaties of the Geysers-Calistoga Known Geothermal Resource Area (KGRA) due to development-related or other site-specific activities. This sediment plan is one part of a four part venture - the others are water quality, benthic invertebrates and fisheries studies. Included are the cost breakdowns for each phase, maps and rationale of the sampling sites, the methodology for the laboratory sample processing, and examples of the type of graphic and tabular output expected. T.M.

N82-21782# California Univ., Livermore. Lawrence Livermore Lab.
BASELINE HEALTH EFFECTS DATA APPLICABLE TO ANTICIPATED GEOTHERMAL RESOURCE DEVELOPMENT IN IMPERIAL COUNTY Final Report
Margaret Deane and Jeffrey L. Hahn Jun. 1981 17 p Prepared in cooperation with California Dept. of Health Services
(Contract W-7405-eng-48)
(DE82-001669; UCRL-15391) Avail: NTIS HC A02/MF A01

The effects of budget cuts on the original contract proposal are described. A task by task description of the program is presented including results and outcome of the task. DOE

N82-21783# California Univ., Livermore. Lawrence Livermore Lab.
IMPERIAL COUNTY BASELINE HEALTH SURVEY POTENTIAL IMPACT OF GEOTHERMAL ENERGY
Margaret Deane (Calif. State Dept. of Health Services) Jun. 1981 169 p
(Contract W-7405-eng-48)
(DE82-001672; UCRL-15392) Avail: NTIS HC A08/MF A01

The survey purpose, methods, and statistical methods are presented. Results are discussed according to: area differences in background variables, area differences in health variables, area differences in annoyance reactions, and comparison of symptom frequencies with age, smoking, and drinking. Included are tables of data, enumeration forms, the questionnaire, interviewer cards, and interviewer instructions. T.M.

N82-21786# Systems Applications, Inc., San Rafael, Calif.
NO SUB x REGULATORY CHANGES AND THE ELECTRIC UTILITY: A GUIDANCE MANUAL FOR AIR QUALITY MODELING IN PLANNING, SITING, AND EMISSIONS CONTROL Final Report
S. R. Hayes, P. D. Gutfreund, S. D. Reynolds (KVB, Inc., Irvine, Calif.), R. Pease (KVB, Inc., Irvine, Calif.), and L. Muzio Sep. 1981 149 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1375)
(DE82-900966; EPRI-EA-2050) Avail: NTIS HC A07/MF A01

Several regulatory changes that are likely to influence requirements for the control of nitrogen oxide emissions from power plants are discussed. The possible requirement for a short-term ambient standard for NO2, prevention of significant deterioration rules for NO2, and visibility protection regulations are also discussed. A guidance manual, a reference document designed primarily for the utility reader, is presented. The potential implications of the possible NO/sub x/-related regulations, current regulatory and permitting requirements, and surveys of NO/sub x/ control technology costs and capability are evaluated. The conduct of a NO2 air quality impact analysis is also discussed. Other topics presented include: a modeling strategy: screening analysis; and selection of appropriate models, data requirements, and costs. M.D.K.

N82-22020# Department of Energy, Mines and Resources, Ottawa (Ontario). Mining Research Labs.
GEOLOGICAL DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES
D. F. Coates, G. Larocque, and L. Geller 1980 23 p
(CANMET-79-29) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries

The problem of safe disposal of various types of radioactive wastes from nuclear power plants is discussed. Mining waste and mill tailings containing toxic radium are produced in large quantities. It is believed about 80 million tons have already accumulated at Elliot Lake, Ontario, alone and that this may increase by the year 2000 to several hundred million tons. These tailings are in bulk but relatively low in radioactivity. Wastes from nuclear generating stations, on the contrary, are highly radioactive but relatively small in volume. A brief overview of how electricity is generated by means of nuclear power, and reasons which render safe disposal of high-level nuclear wastes a particularly difficult and multifaceted problem are discussed. It is suggested that under Canadian conditions deep underground burial of these wastes in mined-out facilities in igneous rocks is the most acceptable solution. M.D.K.

N82-22082# Committee on Science and Technology (U. S. House).
RISK: ASSESSMENT, ACCEPTABILITY AND MANAGEMENT
Washington GPO 1981 122 p Rept. presented to the Subcomm. on Sci., Res. and Technol. Transmitted to the Comm. on Sci. and Technol., 97th Congr., 1st Sess., Nov. 1981 Prepared by Congressional Research Service, Library of Congress
(GPO-87-593) Avail: Subcomm. on Sci., Res. and Technol.

Risk assessment, particularly of risks to the public health resulting from government and industry decisions, is discussed. Cost/benefit analysis as applied to such situations as human deaths and the contracting of cancer by humans is discussed. The role of government regulations and standards is discussed. R.J.F.

N82-22106# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computer Science.
OPTIMIZATION PROGRAMS FOR ECONOMIC ENERGY MODELLING PROBLEMS
Susan M. Hodson Oct. 1981 43 p refs
(Contract EEC-680-79-1-EM-UK)
(NPL-DNACS-51/81; EUR-7548-EN; ISSN-0143-734X) Avail: NTIS HC A03/MF A01

The use of MINOS and MINOS/AUGMENTED programs in linear programming and nonlinear optimal control models is described. The programs take advantage of general sparsity in the matrix of first derivatives of the constraints, which allows the solution of large problems, like finding the optimal fuel-mix and investment proposals to minimize the overall discounted cost covering all the supply utilization sectors of the energy system on a multinational, multiperiod scale. A model is used which predicts aggregate final energy demand and aggregate costs for the European economies over a 10 yr period. Author (ESA)

N82-22111# Public Technology, Inc., Washington, D. C.
URBAN CONSORTIUM Final Report
J. K. Parker 1981 10 p
(Grant NSF ISP-78-12729)
(PB82-122789; NSF/ISP-81020) Avail: NTIS HC A02/MF A01 CSCL 13B

Needs and priorities were assessed for the areas of transportation, community and economic development, and management, finance and personnel were evaluated. Workshops were conducted to (1) assess the condition of urban infrastructure and developing future policies; and (2) study the use of emerging energy technologies in urban management. A study of multi-year revenue and expenditure forecasting and a study on the use of fire data were made. City-led research projects included evaluating landfill gas as an energy source; developing methodol-

ogy for energy impact analysis of community development projects; developing a primary urban energy planning methodology handbook; and retrofitting municipal buildings with solar energy systems. GRA

02
SOLAR ENERGY

Includes solar collectors, solar cells, solar heating and cooling systems, and solar generators.

A82-18890 Combined photovoltaic/thermal solar array DC electrical model. J. S. Krikorian, Jr. *IEEE Circuits and Systems Magazine*, vol. 3, Dec. 1981, p. 7-13. 6 refs. Contract No. DE-AC03-79CS-30205.

An electrical model of a combined photovoltaic/thermal solar array has been developed to predict the steady state behavior of the line currents, power output and array voltage. The effects of temperature on the solar cell characteristics is included in the analysis. The model includes line isolation diodes and 'open cell' bypass diodes. A numerical procedure based on the Contraction Mapping Fixed Point Theorem is used to solve the associated nonlinear equations. (Author)

A82-19295 Performance of collector/storage solar water heaters - Arbitrary demand pattern. M. S. Sodha, P. K. Bansal, and N. D. Kaushik (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 229-238. 8 refs.

A82-19296 Selective blacks for enhanced photothermal solar energy conversion. R. C. Agarwal and P. K. C. Pillai (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 239-251. 112 refs.

The optical and physical requirements of selective surfaces for maximum absorption of solar thermal energy are reviewed, along with processes to fabricate the selective coatings. Noting that the solar energy which reaches the ground is usually in wavelengths of 0.3-2 microns, the desired qualities of coatings are listed as stability of performance, good adherence to the substructure, ease of application, low emissivity above two microns, and economical fabrication. Selective surfaces comprise absorber-reflector tandems, which allow or reflect IR passage, multilayer interference stacks, which involve successive deposition of metallic coatings, and controlled surface morphology, which entails either geometric irregularities, Mie scattering films, corrugated surfaces, or wire mesh surfaces. Preparation can be by electrodeposition, chemical conversion, spray pyrolysis, paint coatings, vacuum deposition, and chemical vapor deposition (CVD), which is stressed as offering the most attractive option for economical large scale coating of solar selective surfaces. M.S.K.

A82-19298 Model evaluation and optimum collector slope for a tropical country. H. P. Garg and S. N. Garg (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 299-312. 13 refs.

Various models for predicting the radiation on an inclined surface are compared and an anisotropic model is used to determine an optimum solar collector slope based on the maximum solar energy availability. The effectiveness of operating a receiver in three modes was examined: facing south with a variable tilt, a fixed tilt and azimuthal sun tracking, and sun-following with maintenance of normal incidence. Three pyranometers were employed to simulate receivers in the different modes. A single tilt equal to the latitude of the location was found to be optimum for a fixed tilt collector, while partially tracking collectors show no dependence on latitude. Partially tracking and fully tracking surfaces received 16-20% more radiation than fixed surfaces, although the gain with fully tracking surfaces exceeded the partially tracking by only 2.5%, which led to a recommendation for the partially tracking configuration. M.S.K.

A82-19448 Solar energy storage and thermal use of an unconfined aquifer. H. Umemiya, E. Haga, R. Miyazawa, and M. Urushidani (Yamagata University, Yonezawa, Japan). *Energy Developments in Japan*, vol. 4, July 1981, p. 15-30. Translation.

An experiment using a large area, shallow aquifer for seasonal thermal storage is discussed. Two wells were drilled 70 m apart and water was pumped up from one well during the winter, and drained over a rooftop to melt snow before running back into another well-bore. During the summer, the well water is pumped up from the cool well, through a solar collector (the rooftop), and back into the warm well. A collection efficiency of 70% was determined for the summer cycle, and winter use from March-December revealed a water temperature of 8.5 C with a total injected volume of 14,700 cu m. The subsequent discovery that water returned to the ground quickly rose 4 C in temperature was taken as proof that the unconfined aquifer washed out the cooler water, implying that a one-well system is sufficient as a snow melter and collector fluid source in the winter. M.S.K.

A82-19825 † Solar-energy perspectives (Perspektivy solnechnoi energetiki). Iu. S. Bortnikov, N. S. Lidorenko, G. F. Muchnik, S. V. Riabikov, and D. S. Strebkov. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Nov.-Dec. 1981, p. 3-12. In Russian.

The current status and perspectives of solar energy utilization are briefly reviewed. Optimal techniques for the design and application of solar energy converters are described, and the possible contribution of solar energy to the future energy economy is assessed. Particular consideration is given to the role of satellite solar power stations. B.J.

A82-19876 Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, December 2-4, 1980, Proceedings. Conference sponsored by the Japan Society of Applied Physics and Science Council of Japan. *Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2. 244 p.

The state-of-the-art in amorphous solar cells is reviewed in terms of polycrystalline silicon solar cells, single crystal silicon solar cells, and methods of characterizing solar cells, including dielectric liquid immersion to increase cell efficiency. Compound semiconductor solar cells are explored, and new structures and advanced solar cell materials are discussed. Film deposition techniques for fabricating amorphous solar cells are presented, and the characterization, in addition to the physics and the performance, of amorphous solar cells are examined. M.S.K.

A82-19877 Invited - Recent progress in amorphous silicon research and photovoltaic applications in the U.S.A. J. L. Stone (Solar Energy Research Institute, Golden, CO). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 1-7. 19 refs.

The progress in the development of amorphous silicon solar cells is traced from 1969-1980, including ongoing research projects, divisions of research, and directions and techniques. Contracted studies are being undertaken of advanced amorphous materials, physical phenomena in amorphous materials, and new materials and techniques. Principal attention is being given to hydrogenated and fluorinated amorphous Si, amorphous B-H, amorphous Si-C, Si-Ge alloys, amorphous GaAs, and other modifiers. Thin film preparation methods such as glow discharge plasma deposition, reactive sputtering, CVD, and ion plating are being investigated. Efficiencies of 6% have been reached, and problems of dopant-Si alloy forming are discussed with a view to improving the conductivity of the doped layers by using fluorinated materials. A realistic goal of 8% is predicted in the near term, and 10% in the 1990's. M.S.K.

A82-19878 An analysis of EBIC response of ITO/poly-Si solar cells. N. Inoue, T. Miyakawa (Defence Academy, Yokosuka, Japan), and C. W. Wilmsen (Colorado State University, Fort Collins, CO). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 11-15. 6 refs. Contract No. XS-9-8232-1.

An EBIC technique is applied to the grain boundaries of an ITO/poly-Si solar cell in order to investigate the effect of grain boundaries on solar cell output. The results are well explained by solving a three-dimensional diffusion equation. It is found that the

regions with reduced EBIC signals around the grain boundaries are much smaller than the bulk diffusion length. The difference between the EBIC profile and that of local cell photoresponse is pointed out and a way to estimate the latter is proposed based on the information from the EBIC profile. (Author)

A82-19879 Rapid characterization of solar cell performances. H. Takakura, T. Nishino, and Y. Hamakawa (Osaka University, Toyonaka, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 17-21. 6 refs.

A new technique of computer-assisted automated measurements and analyses for solar cell output characteristics has been developed. A curve-fitting method developed in this work permits the estimation of solar cell parameters such as the saturation current, n-value, etc. A quantitative correlation between these parameters and fabrication conditions is discussed. This automated system also enables the user to calculate the real photocurrent from output characteristics. More precise analyses of the solar cell output parameters are discussed. (Author)

A82-19880 Characterization of 3-inch solar cells fabricated from granular silicon obtained in a fluidized-bed reactor. T. Warabisako, S. Matsubara, H. Itoh, T. Saitoh, T. Tokuyama (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, Japan), K. Matsukuma (Hitachi Ltd., Hitachi Works, Hitachi, Ibaraki, Japan), and N. Hasegawa (Shin-Etsu Chemical Co., Ltd., Research and Development Laboratory, Niigata, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 23-27. 5 refs. Research supported by the Ministry of International Trade and Industry.

Industrial feasibility of a solar-grade silicon material for use in terrestrial solar cells is demonstrated through the fabrication of practical size, 3 in. diameter, solar cells. The granular silicon prepared in a fluidized-bed reactor consumes less energy than the current Siemens process. A polycrystalline ingot obtained by the Czochralski method is described as a function of ingot length in terms of electrical properties and solar cell performance. Impurity gettering is also attempted through the application of a phosphorus diffusion process. The possibility of realizing a conversion efficiency higher than 8% for an entire ingot is revealed. (Author)

A82-19881 Fabrication and properties of silicon solar cells using squarely shaped crystals. E. Kuroda, S. Matsubara, T. Saitoh, and T. Tokuyama (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 31-37. 10 refs. Research supported by the Ministry of the International Trade and Industry.

Square single crystal silicon ingots with 3-inch sides are grown by producing uniform melt temperature distribution in the crucible. The growth of square ingots is described in a model where supercooling is present at the growth interface, and where growth rates vary for different faces. A relatively high conversion efficiency of 12-13% is obtained from square solar cells. Inhomogeneities in the solar cells are revealed by studying laser-beam induced current images and crystal defect density distribution. The packing density in modules increases up to the 0.93-0.95 level. As a result, modular efficiency also increased by 20%, compared with when using circular wafers. (Author)

A82-19883 Junction and bulk region characteristics of the laser annealed Si solar cells. A. Usami and H. Nishioka (Nagoya Institute of Technology, Nagoya, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 45-49. 7 refs.

The diffusion length in the bulk region and carrier lifetime near the junction in laser annealed Si solar cells are presented. The excess currents in the low forward bias region and the reverse currents of the laser annealed cells were observed to be larger than those in an 800 deg C furnaced annealed cell, implying the existence of residual defects near the junction in the laser prepared cells. The spectral response of the laser annealed cell was equal to that of the furnace annealed cell, while the minority carrier diffusion length in the laser annealed cells was three times that of the furnace annealed cell, which means a better response at higher wavelengths for the laser annealed crystals. Degradation in the solar cells was noted to occur when the laser pulse energy was above 1.5 J/sq cm. M.S.K.

A82-19884 Fundamental properties of MIS solar cells using Mg-p Si system. H. Matsura, S. Nishino, and H. Matsunami (Kyoto University, Kyoto, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 51-55. 8 refs.

Existence of an inversion layer at the surface of Si in an MIS diode using the Mg-p Si system is confirmed by the analysis of C(-2)V characteristics and charges in the inversion layer are estimated. The diode is thought to behave like a p-n junction diode, since minority carrier current is dominant in I-V characteristics. Effects of oxidation time on the C(-2)-V and I-V characteristics are studied. Photovoltaic properties of this inversion type MIS diode are measured. (Author)

A82-19885 A large active area Be-Si MIS solar cell with textured surface. Y. Maeda (Hoxan Corp., Research Laboratories, Sapporo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 57-60. 5 refs.

Experiments on an MIS solar cell using Be as a barrier metal are reported. A Be layer was deposited on boron doped Si wafers by a vacuum deposition technique, resulting in a layer 100-250 A thick. The resulting Be-Si MIS cell displayed an open circuit voltage of 0.5 V, short circuit current density equal to 27.3 mA/sq cm, a fill factor of 0.62, and an efficiency of 8.5%. The preparation of large active area cells is described for 4 sq cm cells, including the electron beam induced vapor deposition at a rate of 15 A/sec. Efficiencies of about 7% were obtained for several cells, with an optimum angle of incidence between 70 and 80 deg. The angular dependence was discovered to be a result of pyramidal shadowing in the deposited layer. Finally, it is noted that a double layered grid electrode consisting of the Be and aluminum contact metal was fabricated, which prevented leakage between the front contact and the textured Si surface. M.S.K.

A82-19888 Parallel- and radial-current stream-line type metal-contacts of solar cell. K. Yonei (Shibaura Institute of Technology, Tokyo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 73-76. 5 refs.

The relation of the window-side metal contact structure to loss in the transparent-conduction region of a solar cell is analytically described. It is assumed that the current is perpendicular to the boundary of the transparent-conduction region, and a basic equation is formulated to define the parallel current and radial current streamlines extending to the metal-contact structures in the back of the cell. It is shown that the larger the surface resistivity of the transparent-conduction region becomes, the larger the difference between the values of the power density of the parallel and radial current streamlines becomes. It is concluded that the chance of losing the window-side metal contact leads to a necessity of fabricating the cells into radial current streamline cells, which have a surface resistivity one order of magnitude lower than the parallel current streamline cells. M.S.K.

A82-19889 Efficiency increase of solar cells operated in dielectric liquid. T. Ugumori and M. Ikeya (Yamaguchi University, Ube, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied*

Physics, vol. 20, 1981, Supplement 20-2, p. 77-80. 6 refs.

Light collection by means of refraction and inner reflection by solar cells immersed in dielectric liquids is investigated, along with the adsorption of polarizable molecules in the liquid. Solar cells with varying p-n junction depths were used to examine the adsorption effect, and current-voltage characteristics and depletion layer capacitance were measured to ascertain the effect of the polarizable molecules. The cells were illuminated by laser light in baths of benzene, ethyl ether, acetone, ethyl alcohol, and methyl alcohol. The photocurrent increased with an increase in the wavelength of the laser light, while the voltage did not increase as quickly. The polarizable molecules are interpreted as suppressing the surface recombination, a factor which overshadows any changes due to reflection. The molecules are thought to adsorb into the antireflection coatings of the cells. M.S.K.

A82-19891 High efficiency MOS solar cells by anodic oxidation processes. H. Yamamoto, M. Moniwa, T. Sawada, and H. Hasegawa (Hokkaido University, Sapporo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 87-91. 14 refs.

Preparation of GaAs, InP and Si single-crystal MOS solar cells by anodization in various modes is investigated. Both passive and active modes of anodization are found to increase the open-circuit voltage with respect to that of the bare Schottky cell. The best result is obtained by active anodization of n-GaAs. Passive anodization with a high formation voltage results in an anomalous reduction in photocurrent. A detailed analysis of cell current-voltage characteristics indicates that cell behavior is dominated by interface-states. (Author)

A82-19893 A new structure for high efficiency and humidity resistant AlGaAs/GaAs solar cells. K. Mitsui, S. Yoshida, T. Oda, Y. Yukimoto, and K. Shirahata (Mitsubishi Electric Corp., Itami, Hyogo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 99-103. 7 refs.

A82-19894 Performance of 1 kWp AlGaAs/GaAs terrestrial concentrator solar cell array. S. Yoshida, K. Mitsui, T. Oda, Y. Yukimoto, and K. Shirahata (Mitsubishi Electric Corp., Itami, Hyogo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 105-108. 6 refs.

A 1 kWp (electrical output power at 100 mw/sq cm incident power density) concentrating photovaltaic array with 180 square Fresnel lenses and AlGaAs/GaAs concentrator solar cells has been constructed. The AlGaAs/GaAs concentrator solar cells consist of p-AlGaAs/p-GaAs/n-GaAs with an area of 2 x 2 sq cm. The p-GaAs layer thickness is set at 3-5 microns so as to keep the spreading resistance low. The concentrator cells are passively cooled by natural convection. The maximum output power from the best concentrator cell is 9.1 with an efficiency of 22.6% at about 125 suns. An array output power of 977 W has been obtained at 125 suns. (Author)

A82-19895 Photovoltaic effect in monoclinic ZnP2. K. Ito, Y. Matsuura, T. Nakazawa, and H. Takenouchi (Shinshu University, Nagno, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 109-112. 5 refs.

Heterojunction diodes consisting of n type In2O3 film and p type monoclinic ZnP2 single crystal were formed. Spectral response of monoclinic ZnP2 was measured on these diodes using polarized monochromatic light. At wavelengths around 0.76 micrometer, the response for the electric vector of plane polarized light parallel to the c-axis was considerably larger than that for the light polarized perpendicular to c. The anisotropy of the response corresponds to an intense dichroism observed in the absorption spectrum of monoclinic ZnP2. The overall response observed within the 0.35-0.86 micrometer range matches with the solar spectrum. (Author)

A82-19896 Growth and evaluation of n-CdS/n-InP/p-InP heteroface solar cell. A. Yoshikawa, S. Yamaga, and H. Kasai (Chiba University, Chiba, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 113-117. 15 refs.

Fabrication and electrical and optical characteristics of an n-CdS/n-InP/p-InP heteroface solar cell are described. The cell was fabricated by two growth steps, i.e., first, a thin n-InP layer was grown on a p-InP substrate by a conventional LPE technique, then a thin n-CdS layer was grown on the n-InP layer by the close-spaced technique. It is shown that the photoresponse of an n-InP/p-InP homojunction cell is remarkably improved by applying a CdS layer on the n-InP because the surface recombination velocity on the n-InP reduces after a CdS growth. Furthermore, the reverse saturation current and the built-in voltage of the InP homojunction are also improved after a CdS growth. The conversion efficiency of the heteroface solar cell with no AR coating was 10.4% under AM2 conditions. The lower observed efficiency than that expected theoretically is attributed to a poor electrical characteristic of the n-InP/p-InP homojunction. (Author)

A82-19897 InGaAsP/InP wavelength division solar cells. N. Ito, S. Hattori (Nagoya University, Nagoya, Japan), T. Uesugi, S. Sakai, and M. Umeno (Nagoya Institute of Technology, Nagoya, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 121-125. 9 refs.

Two types of InGaAsP/InP wavelength division solar cells are fabricated. One of them includes a shallow homojunction and the other has a heteroface structure. A combination of the present cell and a conventional high efficiency GaAlAs/GaAs cell is proposed in this paper. The fabricated first type of cell exhibited a conversion efficiency of 11% for total solar illumination and 18.5% for filtered illumination with GaAs crystal. Neglecting the optical loss in filter material, the possibility that a 26% conversion efficiency will be obtained in the proposed system is demonstrated. The initial results on the second type of cell are presented and an 8.71% conversion efficiency was obtained with a single p-n junction InGaAsP/InP heteroface solar cell. (Author)

A82-19898 Design and performances of a triple /GaAs, Si, and Ge/- solar-cell system with multi-layered spectrum splitters. H. Sakaki, T. Tanoue, K. Yokoyama, Y. Sekiguchi (Tokyo, University, Tokyo, Japan), D. C. Sun (Mitsubishi Electric Corp., Itami, Hyogo, Japan), and Y. Yukimoto. *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 127-133. 6 refs.

A calculation has been performed to predict the ultimate conversion efficiency of various split-spectrum multiple-solar cell systems. Based on this analysis, a triple-cell system is designed and fabricated in which the solar radiation is divided by multilayered filters into three beams of different spectral bands; the beams are then converted separately by a GaAs-, an Si-, and a Ge-cell. A total conversion efficiency of 22.7% is achieved. The factors determining the efficiency are examined to clarify possible methods of attaining higher efficiencies. (Author)

A82-19902 Effect of fluorine on the photovoltaic properties of amorphous silicon prepared by dc glow discharge. K. Nishihata, M. Konagai, K. Takahashi (Tokyo Institute of Technology, Tokyo, Japan), and K. Komori (Showa Oil Co., Tokyo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 151-155. 14 refs. Research supported by the Ministry of International Trade and Industry.

Amorphous Si-F-H films were prepared by dc glow discharge in an atmosphere of SiF4 + H2. The electrical and optical properties have been described. Infrared spectra of amorphous Si-F-H have been studied for various deposition pressures. In the n-type doping characteristics, the maximum conductivity obtained is 10.0/ohm-cm

with the addition of 500 vppm PH3. The Schottky barrier a-Si-F-H solar cell shows an efficiency of 3.5% under AM1, 100 mW/sq cm insolation. (Author)

A82-19903 Properties of amorphous Si:F:H film and its photovoltaic characteristics. Y. Kuwano, M. Ohnishi, H. Nishiwaki, S. Tsuda, and H. Shibuya (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 157-162. 9 refs. Research supported by the Ministry of International Trade and Industry.

The optical and electrical characteristics of a-Si:F:H films deposited by RF glow discharge and the photovoltaic properties of the a-Si cells using the films are discussed, in addition to the presentation of a new phenomenon in a-Si solar cells. Glow discharge deposition of a-Si:H and a-Si:F:H films in SiH4 and SiF4 + SiH4, respectively, were accomplished by an RF capacitive system at a pressure of 0.4 Torr. Glass/ITO/p-i-n cells were also fabricated with a boron doped p-layer of about 50-800 A, an undoped layer of 1000-20,000 A, and a phosphorus doped n-layer 100-1500 A thick on an ITO transparent film deposited on glass. Investigation of the properties of the a-Si:F:H films in terms of IR transmittance revealed a peak at 830/cm, implying that the deposited film contains fluorine. A decrease in efficiency with an increase in light intensity was observed to be less than that which occurs in a-Si:H cells. M.S.K.

A82-19905 Dependence of RF power on the content and configuration of hydrogen in amorphous hydrogenated silicon by reactive sputtering. T. Imura, K. Ushita, K. Mogi, and A. Hiraki (Osaka University, Suita, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 171-174. 10 refs.

Infrared absorption spectra at stretching bands of Si-H were investigated in hydrogenated amorphous silicon fabricated by reactive sputtering in the atmosphere of Ar and H2 (10 mole%) at various input RF powers in the range from 0.8 to 3.8 W/sq cm. Hydrogen content mainly due to the configuration of Si = H2 in the film increased with the decreasing RF power, as the deposition rate was decreased. On the other hand, the quantity of the monohydride (Si-H) configuration depended less on the power. Attachment of hydrogen molecules onto the fresh and reactive surface of silicon deposited successively was proposed for possible process of hydrogen inclusion into amorphous silicon resulting in Si = H2 configuration. The photoconductivity increased as the input power became higher, when the deposition rate also increased linearly with the power. (Author)

A82-19909 Interpretation of characteristics in a-Si:H solar cells. Y. Uchida, H. Sakai, and M. Nishiura (Fuji Electric Corporate Research and Development, Ltd., Yokosuka, Kanagawa, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 191-194. 12 refs. Research supported by the Ministry of International Trade and Industry.

Current versus voltage characteristics in an illuminated a-Si:H solar cell which shows conversion efficiency of 4.3% (cell area of 1.0 sq cm) are interpreted by assuming a simplified junction model and a distribution of the density of states in the band gap. Since the width of the depletion region relates to this distribution, a depletion width (W) versus bias voltage (V) relation can be calculated from this distribution. Also, another W-V relation is obtained from light-generated current data on the basis of a few assumptions. These two different estimations of the W-V relation excellently agree when one assumes a hyperbolic distribution of the density of states in the band gap which is symmetric with respect to the middle of the energy band gap and has a density of mid-gap states of 8.3 x 10 to the 15th per cu cm eV. This values are comparable to the minimum density of states in a-Si:F:H reported by Czubatyj et al. (1980). (Author)

A82-19911 Schottky barrier solar cells of weakly hydrogenated CVD amorphous silicon. T. Nakashita, M. Hirose, and Y. Osaka (Hiroshima University, Hiroshima, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 201-204. 9 refs.

Electronic properties of CVD a-Si were remarkably improved by hydrogen plasma annealing. As a result, the Schottky-barrier solar cells without an antireflection coating have provided a conversion efficiency of 2.7% at 100 mW/sq cm, and no Staebler-Wronski effect has been observed in the hydrogenated CVD a-Si cell. It is also found that the fill factor is dependent on incident light intensity, because of changes in its series and parallel resistances by light illumination. (Author)

A82-19912 Characteristics of Schottky barrier diodes in reactively sputtered amorphous Si:H. H. Okushi, K. Nakagawa, H. Yamamoto, A. Matsuda, K. Tanaka, S. Iizima (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan), S. Yamasaki, and M. Matsumura (TOA Nenryo Kogyo KK, Tokyo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 205-209. 6 refs.

Experiments with Schottky barrier diodes in reactivity sputtered a-Si:H films to investigate the diode characteristics on the basis of film properties are reported. The H content, optical gap, activation energy, spin density, and diode characteristics such as I-V, C-V, and photovoltaic properties are discussed in terms of the bonded H-content. The samples were prepared in a diode sputtering system and the H2 content was varied, with the Schottky diodes in an n+ crystalline Si configuration having Au contacts. The bonded H and median wave number were determined by film thickness and IR absorption spectroscopy. The effective density of gap states was found to decrease with increasing H content, and discussions are presented of the transient current characteristics and the illuminated diode characteristics. M.S.K.

A82-19913 A new integrated type amorphous Si solar cell. Y. Kuwano, S. Tsuda, M. Ohnishi, H. Nishiwaki, H. Shibuya, S. Nakano, and T. Imai (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 213-218. 7 refs. Research supported by the Ministry of International Trade and Industry.

The conversion efficiencies of amorphous silicon (a-Si) solar cells were found to decrease with an increase of the cell size. The cause of this effect was investigated, and a part of the cause was indicated by a distributed constant model. In order to enlarge the size of a solar cell with high efficiency, an integrated structure has been developed for the a-Si solar cell module. The best conversion efficiency of this module with a size of 10 x 10 sq cm was 3.4% in sunlight. (Author)

A82-19914 Optimizations of the film deposition parameters for the hydrogenated amorphous silicon solar cell. Y. Tawada, T. Yamaguchi, S. Nonomura, H. Okamoto, Y. Hamakawa (Osaka University, Toyonaka, Japan), and S. Hotta. *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 219-225. 12 refs.

A82-19915 Broadening of spectral response width by a-Si/a-SiGe p-i-n type solar cells. G. Nakamura, K. Sato, Y. Yukimoto, and K. Shirahata (Mitsubishi Electric Corp., LSI Research and Development Laboratory, Itami, Hyogo, Japan). *(Japan Society of Applied Physics and Science Council of Japan, Photovoltaic Science and Engineering Conference in Japan, 2nd, Tokyo, Japan, Dec. 2-4, 1980.) Japanese Journal of Applied Physics*, vol. 20, 1981, Supplement 20-2, p. 227-232. 11 refs. Research supported by the Ministry of International Trade and Industry.

A82-19948 Turbomachinery for small solar power plants. K. Bammert (Hannover, Universität, Hanover, West Germany), H. Helkal (Helwan University, Cairo, Egypt), and A. Mobarak (Cairo University, Cairo, Egypt). *Forschung im Ingenieurwesen*, vol. 47, no. 6, 1981, p. 169-178. 5 refs.

The considered investigation is concerned with the selection of turbomachinery for a thermodynamic cycle involving the employment of working fluids at different maximum process temperatures, taking into account the power range from 10 to 500 kW. Approaches for determining system efficiency are discussed. It is pointed out that in selecting the thermodynamic cycle and the working fluid for a solar power plant, the primary consideration must be related to the necessity to obtain a simple, reliable system which meets also the efficiency requirements. The Rankine cycle and the Brayton cycle are described, and the design of suitable turbines and compressors is considered. It is found that solar farm plants using parabolic troughs or bowls are best suited for process temperatures in the range from 200 to 300 C and for power outputs up to 500 kW. For the considered conditions, steam and toluene are the most suitable working fluids in a Rankine system. G.R.

A82-20066 Macroscopic surface roughness in metal-dielectric composite films - Photothermal absorber applications. G. A. Nyberg and R. A. Buhrman (Cornell University, Ithaca, NY). *Applied Physics Letters*, vol. 40, Jan. 15, 1982, p. 129-131. 9 refs. NSF-supported research; Contract No. DE-FG02-80CS-83113.

Previous studies have shown that coevaporated metal-dielectric composite films are quite smooth. But a substantially higher deposition temperature results in the surface roughness of Mo/Al2O3 composite films becoming larger than the mean film thickness. This effect was applied to photothermal solar absorbers where, for the first time, a stable selective absorber was produced which absorbs over 99% of the solar spectrum. These results have implications for other surface roughness dependent effects. (Author)

A82-20070 Silicon-silicon interfaces. D. Redfield (RCA Laboratories, Princeton, NJ). *Applied Physics Letters*, vol. 40, Jan. 15, 1982, p. 163-165. 14 refs. Research supported by RCA; Contract No. DE-AC01-79ET-23108.

A wide variety of measurements on silicon grain boundaries shows that the electronic properties of such boundaries are much like those of Si surfaces in all essential respects. Moreover, the properties of 'clean' surfaces and lightly contaminated surfaces can be studied on many crystallographic orientations of the interfaces without the need for vacuum measurements. Such grain boundaries may therefore be regarded as Si-Si interfaces in the sense used in surface physics. It is shown that the thermal history and the dissolved oxygen of the silicon play major roles in determining the interface properties. (Author)

A82-20136 * Solar/hydrogen systems for the 1985-2000 time frame - A review and assessment. J. A. Hanson (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), R. W. Foster, W. J. D. Escher, and R. R. Tison (Escher-Foster Technology Associates, Inc., St. Johns, MI). *International Journal of Hydrogen Energy*, vol. 7, no. 1, 1982, p. 3-20. Research sponsored by the U.S. Department of Energy and NASA.

A comprehensive state-of-the-art review of solar/hydrogen technologies has been conducted. From this, solar/hydrogen production systems which could be commercialized by the year 2000 have been characterized technically and economically. Incentives and disincentives for the early commercialization of four solar/hydrogen systems have been explored, conclusions drawn and recommendations made. (Author)

A82-20139 * Urban air pollution and solar energy. R. B. Gammon (New South Wales, Energy Authority, Sydney, Australia), J. R. Huning, M. S. Reid, and J. H. Smith (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *International Journal of Ambient Energy*, vol. 2, Oct. 1981, p. 183-195. 49 refs. Contract No. NAS7-100.

The design and performance of solar energy systems for many potential applications (industrial/residential heat, electricity generation by solar concentration and photovoltaics) will be critically affected by local insolation conditions. The effects of urban air pollution are considered and reviewed. A study of insolation data for Alhambra, California (9 km south of Pasadena) shows that, during a recent second-stage photochemical smog alert (greater than or equal to 0.35 ppm ozone), the direct-beam insolation at solar noon was reduced by 40%, and the total global by 15%, from clean air values. Similar effects have been observed in Pasadena, and are attributable primarily to air pollution. Effects due to advecting smog have been detected 200 km away, in the Mojave Desert. Preliminary performance and economic simulations of solar thermal and photovoltaic power systems indicate increasing nonlinear sensitivity of life cycle plant cost to reductions in insolation levels due to pollution. (Author)

A82-20165 SHAC - A nation turns to the sun. N. Lihach. *EPRI Journal*, vol. 6, Dec. 1981, p. 13-17.

The state-of-the-art and applications of solar heating and cooling are discussed. Domestic hot water heating is considered as a currently viable, commercially acceptable technique, with progress moving rapidly in the area of building heat. Storage systems, when combined with solar heating systems, are asserted to be a valid method of levelling off utility heating energy supply loads, and studies by the Electric Power Research Institute to identify site specific active solar systems are outlined. The insulation of storage tanks has been found to be a critical factor in solar system economics, with single tank storage being more efficient than multiple tank methods; careful management of the stored hot water use extended a system's effectiveness. Other findings showed that hot air collectors gathered more thermal energy than liquid filled collectors, liquid storage is more efficient than rock storage, and passive systems are most likely to be used on new houses. M.S.K.

A82-20167 Solar-thermal electric - Focal point for the desert sun. D. Van Atta. *EPRI Journal*, vol. 6, Dec. 1981, p. 37-41, 43. 6 refs.

The applications of solar thermal systems are explored, including flat plate and line-focus collectors, and parabolic and heliostat point focus electrical generators. The first U.S. 10MWe solar tower power plant, Solar One, is due to begin operational testing in 1982, while five other projects are under way in Europe and Japan. Mention is made of the use of solar thermal generators as repowering plants, used to preheat steam for conventional gas and oil fueled power plants. Thermal storage methods, such as molten salt, hot rocks, and hot oil are reviewed, as are Brayton and Rankine cycle heat transfer systems. The Brayton cycle will be tested in a hybrid scheme with a fossil fuel burning gas generator which will supplement the output from the solar thermal section. M.S.K.

A82-20168 Photovoltaics - A question of efficiency. R. Whitaker. *EPRI Journal*, vol. 6, Dec. 1981, p. 45-51. 11 refs.

The current state and requirements for large scale use of photovoltaic cells are examined. Annual sales are presently 4 MW, going primarily to remote communications installations, railway controls, navigation aids, and communications equipment on offshore oil platforms. With a goal of mass-production of cells yielding power at 0.70 cents/W, research programs are investigating crystalline Si, thin film CdS cells, amorphous Si films, etc. Cell module losses include defective cells, faulty wiring, uneven production quality, and losses in efficiency at higher temperatures. Higher efficiencies using cheaper cells are being investigated by doping amorphous cells with hydrogen, by laser recrystallization of thin film surfaces, or by employing more expensive cells in concentrator configurations. Utility applications are examined, noting that the ultimate goal is for modular units for home use. M.S.K.

A82-20169 Sea, soil, sky - Testing solar's limits. J. Hopkinson. *EPRI Journal*, vol. 6, Dec. 1981, p. 55-61. 6 refs.

The potentials and actualities of large scale biomass, ocean thermal, and satellite solar power systems are discussed. Biomass is an energy already on-line in installations ranging from home-sized wood-burning stoves to utility sized generators fueled by sawdust and forest residue. Uses of wheat straw, fast-growing trees such as eucalyptus and alder, and euphorbia as biofuels are examined, noting restrictions imposed by land use limitations and the necessity for genetic engineering for more suitable plants. Pyrolysis and thermochemical gasification of biomass to form gaseous, solid, and liquid

fuels are explored, and mention is made of utility refuse and sewage incineration for power generation. OTEC, satellite solar power systems, and tidal generator plants are considered as promising for further investigation and perhaps useful in limited applications, while solar pond power plants require extremely large areas to be effective. M.S.K.

A82-20205 Fabrication of thick narrow electrodes on concentrator solar cells. A. Blakers, P. B. Kosel, M. R. Willison, and M. A. Green (New South Wales, University, Kensington, Australia). *Journal of Vacuum Science and Technology*, vol. 20, Jan. 1982, p. 13-15. 5 refs. Research supported by the National Energy Research Development and Demonstration Council.

Narrow electrodes of thickness greater than 15 microns have been fabricated on concentrator solar cells by the PMTP (photoresist-metal-thick photoresist) process. This technique provides grid lines of low series resistance while minimizing the active area of silicon covered by electrodes, both advantages which increase the conversion efficiency of concentrator solar cells. In addition, as this technique is a 'liftoff' technique, it allows the use of composite or alloy metals which normally suffer in the course of chemical etching. Finally, the thick photoresist layer smooths out short range surface roughness and allows this technique to be used equally effectively on polycrystalline, textured or amorphous surfaces. (Author)

A82-20457 * Photovoltaic investigation of minority carrier lifetime in the heavily-doped emitter layer of silicon junction solar cell. C.-T. Ho (Mobil Tyco Solar Energy Corp., Waltham, MA). *Journal of Applied Physics*, vol. 53, Jan. 1982, p. 507-513. 21 refs. Research supported by the U.S. Department of Energy; Contracts No. NAS7-100; No. JPL-954355.

The results of experiments on the recombination lifetime in a phosphorus diffused N(+) layer of a silicon solar cell are reported. The cells studied comprised three groups of Czochralski grown crystals: boron doped to one ohm-cm, boron doped to 6 ohm-cm, and aluminum doped to one ohm-cm, all with a shunt resistance exceeding 500 kilo-ohms. The characteristic bulk diffusion length of a cell sample was determined from the short circuit current response to light at a wavelength of one micron. The recombination rates were obtained by measurement of the open circuit voltage as a function of the photogeneration rate. The recombination rate was found to be dependent on the photoinjection level, and is positive-field controlled at low photoinjection, positive-field influence Auger recombination at a medium photoinjection level, and negative-field controlled Auger recombination at a high photoinjection level. M.S.K.

A82-20463 Some properties of dc glow discharge amorphous silicon solar cells. H. Wiesmann, C. Coleman (Plasma Physics Corp., Locust Valley, NY), and A. Ghosh (Brookhaven National Laboratory, Upton, NY). *Journal of Applied Physics*, vol. 53, Jan. 1982, p. 703-707. 22 refs. Contract No. DE-AC02-76CH-00016.

A study of the internal yield, depletion width and absorption constant is presented for dc glow discharge P-I-N amorphous silicon films. Internal yields of approximately 0.9 at 475 nm and depletion widths as large as 0.37 microns were observed at low illumination levels and were characteristic of the better cells. The absorption constant as a function of wavelength showed no anomalies and was comparable to RF glow discharge films with an optical gap of 1.68 eV. A unique aspect of these cells is that the top P layer is amorphous boron. (Author)

A82-20464 Improved efficiency of n-CdSe thin-film photoelectrodes by zinc surface treatment. J. Reichman and M. A. Russak (Grumman Aerospace Corp., Research Dept., Bethpage, NY). *Journal of Applied Physics*, vol. 53, Jan. 1982, p. 709-711. 15 refs. Contract No. XP9-8002-8.

The open circuit voltage, fill factor, and power conversion efficiency of n-CdSe thin-film electrodes for photoelectrochemical solar cells have been improved by treating the surface with Zn(+2) ions. The overall efficiency of these electrodes was increased from approximately 5% to as high as 6.5% with a soaking treatment in 1 M ZnCl2. Photoelectrochemical measurement and Auger spectroscopy indicated the observed improvements were the result of a shift in the flat-band potential to more negative values to the incorporation of zinc into the surface region of the CdSe thin film. (Author)

A82-20574 The silicon solar satellite power system - A net energy analysis. B. Hannon and J. P. Naughton (Illinois, University, Urbana, IL). *Energy Systems and Policy*, vol. 5, no. 4, 1981, p. 319-343. 17 refs. Research supported by the National Academy of Sciences.

The physical aspects and net energy balance of a Satellite Solar Power System (SSPS) are examined. The feasibility of operating with or without laser annealing for the cells, possible variations in the total system costs, the projected worth of the energy, and the R&D costs are explored. The energy needed to mine, refine, fabricate, manufacture, launch, and maintain the SSPS materials and structures are included in the energy analysis, and cost-to-energy ratio of energy used to energy produced graphs are provided for the cases of the use or non-use of laser annealing for radiation protection for the solar cells. The resulting energy ratios indicate that the reference SSPS compares unfavorably with coal or nuclear earth-based plants, although further research is necessary to determine what level of technology is actually required for construction of the SSPS. M.S.K.

A82-20642 * # Cost and sizing sensitivities for the solar power satellite. L. Monford, G. D. Arndt, and J. W. Seyl (NASA, Johnson Space Center, Houston, TX). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 48.3.1-48.3.5.

A summary is provided of the characteristics and error parameters of the reference microwave transmission system for the solar power satellite (SPS). The relative importance of electrical and mechanical tolerances upon scattered microwave power and electrical costs is investigated. It is found that small increases in efficiency and/or reduction of losses (less than one percent) can improve the revenue from a single satellite over its 30-year lifetime by several hundred million dollars. Attention is given to a system definition, cost sensitivities for the reference system, the klystron dc-RF conversion efficiency, the transmitting antenna, the rectenna collection efficiency, system sizing tradeoffs, a cost analysis, and multiple antennas. G.R.

A82-20708 * # Solid-state alternatives for the Solar Power Satellite. L. Leopold and G. D. Arndt (NASA, Johnson Space Center, Houston, TX). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 72.1.1-72.1.5.

A solid-state transmitter at S-band frequencies will allow many low-power antenna array elements fed directly by the solid-state amplifier modules to combine power for transmission to earth in space. Two configurations, one the separate antenna and the other a sandwich concept are discussed. The results of two small hardware development studies are presented. (Author)

A82-20722 A high efficiency single-crystal CdSe photoelectrochemical solar cell and an associated loss mechanism. K. W. Frese, Jr. (SRI International, Menlo Park, CA). *Applied Physics Letters*, vol. 40, Feb. 1, 1982, p. 275-277. 13 refs.

The properties of n-CdSe photoelectrochemical solar cells using aqueous alkaline K3Fe(CN)6/K4Fe(CN)6 as the redox couple are examined. Such cells are shown to have a peak conversion efficiency of 12.4% at 13 mA/sq cm and 0.85V, when a solution with pH 13.4 is used. The pH of the solution is found to be very important for obtaining high-efficiency cells. Cell degradation due to selenium corrosion is discussed in terms of a simple model where the dominant degradation mechanism is attributed to light absorption by Se. V.L.

A82-20881 Technological approach towards future large solar arrays. B. Georgens (Telefunken AG, Wedel, West Germany). In: Space in the 1980's and beyond; Proceedings of the Seventeenth European Space Symposium, London, England, June 4-6, 1980. San Diego, CA, American Astronautical Society; Univelt, Inc., 1981, p. 229-250. 5 refs. (AAS 80-323)

Three generations of solar arrays are described, the first being characterized by body mounted arrays, the second by rigid paddle arrays, and the third by the direct bonding of solar cells on thin,

flexible plastic foils. It is pointed out that the use of solar arrays as power sources could significantly increase the capabilities of the Shuttle and Spacelab. Since the capacity for manufacturing solar cells in Europe has been increased to the required level, attention must now be directed to increasing cell efficiency and decreasing cell thickness toward 100 microns. Detailed development is also required in order to meet the retractability and high-voltage requirements in blanket technology. C.R.

A82-20968 Coupling to solar energy: Sensitized photoreactions - The primary source of self-organization. P. Decker (Hannover, Tierärztliche Hochschule, Hanover, West Germany). In: Origin of life; Proceedings of the Third ISSOL Meeting and Sixth ICOL Meeting, Jerusalem, Israel, June 22-27, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 529-536. 31 refs.

Life is modelled as a thermodynamically dissipative mechanism, and the chemical reactions most amenable to the formation of 'bioids' which form and change from one generation to the next are examined. The self-organization is assumed to occur on a planetary surface exposed to 6000 deg light quanta, in the availability of reactive chemicals, with nonenzymatic catalysts being present, and with macromolecules able to mediate the reactivity through catalytic concentration of metal ions. The model is taken to indicate that experimentation should look for photochemical reactions with autocatalytic feedback which yield an organization into cycles in a steady state scenario. The oxidation of methane is mentioned for the production of formaldehyde and the autocatalytic formation of sugars from the formaldehyde, and experiments on a nonenzymatic photophosphorylation is described as an example of the synthesis of energy rich intermediates. M.S.K.

A82-21147 Silicon solar cells with reduced temperature sensitivity. M. A. Green (Solar Energy Research Institute, Golden, CO.; New South Wales, University, Kensington, Australia), K. Emery (Solar Energy Research Institute, Golden, CO), and A. W. Blakers (New South Wales, University, Kensington, Australia). *Electronics Letters*, vol. 18, Jan. 21, 1982, p. 97, 98. 6 refs. Research supported by the Solar Energy Research Institute and Australian National Energy Research Development and Demonstration Council.

As the open-circuit voltage of silicon solar cells continues to improve, one resulting advantage, not widely appreciated, is reduced temperature sensitivity of device performance. Recently a new type of silicon solar cell has been described which has resulted in a significant increase in open circuit voltage. Experimental results are described for these devices which demonstrate the lowest temperature sensitivity ever reported for silicon cells under unconcentrated sunlight. With further improvements in voltage, it should be possible to approach the relative temperature insensitivity of some high performance GaAs devices. (Author)

A82-21149 A comparison of the solar-gas and solar-electric interface. G. G. Mannella (Mechanical Technology, Inc., Latham, NY). *Energy* (UK), vol. 7, Jan. 1982, p. 31-37. 15 refs.

The introduction of large-scale solar-derived gas, electricity, and home heat into the national pipeline, electric grid, and fuel supply systems is discussed. Natural gas is shown to be substitutable for most other energy sources, having a lower cost per energy unit than electricity or oil, and able to be augmented by biomass derived methane or solar derived hydrogen. The latter is perceived as an unproven technology, both economically and technically. Solar home heating systems will lower the utilities' rate base and lead to minimum charge rates for solar customers and higher rates for regular customers unless utilities are permitted to enter the solar heating business as an extension of their role as a service institution. Dispersed solar electric systems are seen to be the least economical use of solar systems, while the solar-gas system offers the greatest potential as a bridge for solar technologies into residential, institutional, and commercial markets. M.S.K.

A82-21150 Solar energy/utility interface - The technical issues. R. D. Tabors and D. C. White (MIT, Cambridge, MA). *Energy* (UK), vol. 7, Jan. 1982, p. 39-48. 10 refs.

The technical and economic factors affecting an interface between solar/wind power sources and utilities are examined. Photovoltaic, solar thermal, and wind powered systems are subject to stochastic local climatic variations and as such may require full back-up services from utilities, which are then in a position of having reserve generating power and power lines and equipment which are used only part time. The low reliability which has degraded some economies of scale formerly associated with large, centralized power plants, and the lowered rate of the increase in electricity usage is taken to commend the inclusion of power sources with a modular nature such as is available from solar derived electrical generation. Technical issues for maintaining the quality of grid power and also effectively metering purchased and supplied back-up power as part of a homeostatic system of energy control are discussed. It is concluded that economic considerations, rather than technical issues, bear the most difficulty in integrating solar technologies into the utility network. M.S.K.

A82-21253 Use of photovoltage for electrodeposition in solar cell processing technology. V. K. Jain (Solid State Physics Laboratory, Delhi, India) and A. R. Kulshreshtha (Indian Space Research Organization, Satellite Centre, Bangalore, India). *Journal of Physics D - Applied Physics*, vol. 14, Dec. 14, 1981, p. 2327-2331. 6 refs.

This paper reports the development of a new technology for the electrolytic deposition of a metal on a solar cell, without employing an external electric bias field, but by using the internal photo-induced voltage of the solar cell itself. The experimental details of depositing silver over the existing metallized contact structure of the cell and a transparent conducting oxide coating over the entire solar cell front surface are discussed. The proposed technique reduces the consumption of the processing materials and makes the fabrication procedure less expensive and simpler. (Author)

A82-21363 Bandpass filters for thermophotovoltaic conversion systems. F. Demichelis, E. Minetti-Mezzetti, M. Agnello, and V. Perotto (Torino, Politecnico, Turin, Italy). *Solar Cells*, vol. 5, Jan. 1982, p. 135-141. 9 refs. Research supported by the Fiat Aviazione S.p.A.

The design of dielectric-metal-dielectric filters especially suitable for use as wide bandpass filters with a high visible and a low IR transmittance is described. A refining method is applied to optimize the transmittance in the part of the spectrum corresponding to the spectral response of the solar cells and at the same time to preserve a high reflectance at longer wavelengths. These filters can provide a considerable transmittance over a wide band of the spectrum with a very low transmittance in the rejection regions. (Author)

A82-21364 Effect of the back-surface field on the open-circuit voltages of p/+/-n-n/+/ and n/+/-p-p/+/ silicon solar cells. S. N. Singh and G. C. Jain (National Physical Laboratory of India, New Delhi, India). *Solar Cells*, vol. 5, Jan. 1982, p. 143-172. 30 refs.

The means by which a back surface field (BSF) improves the open-circuit voltage for solar cells are investigated analytically. Minority carrier blocking, back reflection, and back-contact recombination velocity are discussed, and the effect of a BSF on cell performance is evaluated by defining an effective recombination velocity of minority carriers at the L-H junction end of the bulk region. Low and high energy level conditions in the bulk region are determined, and whereas at low levels the increase is due to the back reflection of minority carriers, at high levels the contribution of minority carrier blocking becomes significant too. The analysis is valid for front-illuminated silicon solar cells if both front and back junctions are shallow. M.S.K.

A82-21365 Optimum operating conditions of a solar cell panel and prediction of solar radiation in Sana'a, Yemen. A. Khogali and M. R. I. Ramadan (Sana'a University, Sana'a, Yemen). *Solar Cells*, vol. 5, Jan. 1982, p. 173-181. 9 refs.

Results of a study of the performance of solar cells under nominal operating conditions in Yemen are reported. The solar cell panel comprised 14 Si cells of .003 sq m surface area each, and was mounted on a rooftop with the solar radiation being measured by a pyranometer. Further monitoring was performed of the panel surface temperature, the ambient air temperature, and potentiometer readings of the panel output. Current-voltage characteristics were recorded at 14 intensities during the day for references to determine

other operating parameters. Efficiency varied as an inverse of the internal cell temperature, ranging from 21.7-17.5% at temperatures of 19 and 28.5 C, respectively. An average of daily irradiation of 21.2 MJ/sq m was calculated for 8.9 hr of sunlight/day and an increase of 10% in output was achieved in the winter by tilting the panel toward the equator. M.S.K.

A82-21366 Effect of shunt resistance and bypass diodes on the shadow tolerance of solar cell modules. M. S. Swaleh and M. A. Green (New South Wales, University, Kensington, Australia). *Solar Cells*, vol. 5, Jan. 1982, p. 183-198. 7 refs.

In the field, solar cell arrays are subjected to shadows from both predictable sources and such unpredictable sources as bird droppings or fallen leaves. The most obvious result of a shadow is a decrease in power output from the solar cell array. However, a more serious problem that can arise is the degradation and eventual failure of the array due to localized overheating. These difficulties can be avoided either by incorporating a relatively small shunt resistance in the solar cell design or by incorporating bypass diodes. In this paper we analyse these techniques and compare their effectiveness. (Author)

A82-21838 The effect of the I sub 01/I sub 02 ratio on the open circuit voltage of solar cells. A. Prasad (Bharat Electronics, Ltd., Bangalore, India). *Solid-State Electronics*, vol. 25, Jan. 1982, p. 80-82.

The relationship between the open-circuit voltage of a solar cell and the value of the ratio I sub 01/I sub 02 is investigated, I sub 01 and I sub 02 being the two leakage currents used is describing the dark characteristics of a solar cell by the two-exponential model. The voltage is found to decrease as the ratio becomes smaller. This reduction in voltage, however, is more pronounced for higher values of I sub 01. The reduction is also found to depend on the mode of variation of the space charge recombination current with applied voltage. C.R.

A82-21949 High-efficiency electrodeposited cadmium telluride solar cells. G. Fulop, M. Doty, P. Meyers, J. Betz, and C. H. Liu (Ametek, Inc., Harleysville, PA). *Applied Physics Letters*, vol. 40, Feb. 15, 1982, p. 327, 328. 10 refs.

Thin-film CdTe Schottky-barrier solar cells with efficiencies in excess of 8% have been produced by electrodeposition from an aqueous solution. The most efficient Au/CdTe solar cell developed to date had an efficiency of 8.65% (under 100 mW/sq cm illumination), and open-circuit voltage of 0.723 V, a short-circuit current density of 18.7 mA/sq cm, and a fill factor of 0.64. Even higher values of these parameters have been obtained individually on other cells. The maximum values measured to date are a short-circuit current of 21.3 mA/sq cm, an open-circuit voltage of 739 mV, and a fill factor of 0.69. V.L.

A82-22040 # Design and construction of a concentrating photovoltaic total energy system in Hawaii. D. Rafinejad and R. Spencer (Acurex Corp., Mountain View, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0069.* 8 p.

Design and construction of Hawaii's largest solar energy system are described. The project was sponsored by the U.S. Department of Energy and the State of Hawaii and was designed and constructed by Acurex Corporation. The system generates 35 kW of DC power at 1,000 W/sqm insolation. The major subsystems are the collector field, thermal energy subsystem, and electrical power generation. The photovoltaic (PV) collector field consists of 4,800 sq ft of parabolic linear focus concentrators. The linear receiver is populated with PV cells and is actively cooled. Project construction is complete and the system is currently being commissioned. (Author)

A82-22190 Effect of absorbed water on an indium oxide-insulator /BeO.SiO2/-p-silicon solar cell. K. Ito and T. Nakazawa (Shinshu University, Nagano, Japan). *Journal of Applied Physics*, vol. 53, Feb. 1982, p. 1110-1114. 30 refs.

Results are presented of a study of the output characteristics of an In2O3/p-Si heterojunction solar cell with an insulating layer of beryllium-treated silicon oxide applied between the indium oxide and the silicon. The cell was fabricated on single crystalline p-type silicon wafers thermally oxidized in O2 by the vacuum evaporation of beryllium and the deposition of indium oxide films. Results of reflection electron diffraction, Auger electron spectroscopy and observations of the beryllium thickness dependence of the heterojunction dark forward currents support the nature of the evaporated beryllium as an insulating oxide. Current-voltage curves of cells under illumination reveal increases in short-circuit current density, fill factor and open-circuit voltage with operating time, which correspond to increases in conversion efficiency from 1.1 to 9.7% in 2800 min. Experiments in which the cell was exposed to flows of various gases reveal this effect to be due to the absorption of water vapor, which introduces traps which assist electron tunneling through the composite oxide layer. A.L.W.

A82-22191 Laser processing for high-efficiency Si solar cells. R. T. Young and R. F. Wood (Oak Ridge National Laboratory, Oak Ridge, TN). *Journal of Applied Physics*, vol. 53, Feb. 1982, p. 1178-1189. 30 refs. Contract No. W-7405-eng-26.

Experiments on the optimal conditions for the laser-annealing of ion-implanted silicon solar cells to obtain cells of high efficiency are presented. Measurements of emitter region electrical characteristics, emitter dopant profiles, junction characteristics and back surface fields at various implantation energies and doses, laser energy densities, and substrate temperatures reveal the highest efficiency p(+)n and p(+)nn(+) cells to be obtained by shallow implantation (5 keV) with high surface concentrations followed by annealing with 1.2 J/sq cm laser pulses with beam homogenization. Substrate heating is also observed to improve the open-circuit voltage. It is also found that efficiencies of over 16% AM1 may be obtained with the use of laser gettering to enhance the minority carrier diffusion length and laser-induced diffusion to incorporate back surface fields in combination with ion implantation and laser annealing. A.L.W.

A82-22230 † Thermoelectric film receivers of radiant energy (Termoelektricheskie plenochnye priemniki luchistoi energii). S. Iazliev (Turkmenskii Gosudarstvennyi Universitet, Ashkhabad, Turkmen SSR). *Akademiia Nauk Turkmenskoi SSR, Izvestiia, Seriia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 6, 1981, p. 33-36. In Russian.

It is noted that, since concentrating systems have come into their own in solar power engineering, a thorough investigation of the heat fields (or concentration coefficient) in the focal and near-focal regions of these systems has become necessary. What is needed is a quantitative determination of the energy concentration in a receiver placed at the focal point of a concentrating system. The use of micromodular thermoelectric film receivers as sensors of power and radiant flux in the focal and near-focal plane of single- and multielement concentrating systems is shown to be theoretically possible. C.R.

A82-23356 Effects of grain boundaries on the current-voltage characteristics of polycrystalline silicon solar cells. A. Neugroschel (Florida, University, Gainesville, FL) and J. A. Mazer (Harris Semiconductor, Inc., Palm Bay, FL). *IEEE Transactions on Electron Devices*, vol. ED-29, Feb. 1982, p. 225-236. 25 refs. Contract No. XS-9-8275-1.

A82-23362 Intensity enhancement in textured optical sheets for solar cells. E. Yablonovitch and G. D. Cody (Exxon, Corporate Research-Science Laboratories, Linden, NJ). *IEEE Transactions on Electron Devices*, vol. ED-29, Feb. 1982, p. 300-305. 8 refs.

A statistical mechanical approach toward the optics of textured and inhomogeneous optical sheets adopted. As a general rule, the local light intensity in such a medium will tend to be 2n-squared(x) times greater than the externally incident light intensity, where n(x) is the local index of refraction in the sheet. This enhancement can contribute toward a 4n-squared(x) increase in the effective absorption of indirect-gap semiconductors like crystalline silicon. (Author)

A82-23391 The effect of length on absorption for a trapezoidal groove collector. V. M. Puri (Solar Energy Research Institute, Golden, CO). *Solar Energy*, vol. 27, no. 6, 1981, p. 463-467. 8 refs.

In practice, the collection efficiency or concentration ratio associated with a finite collector will significantly differ from the

predicted values using infinite collector correlations. In the present investigation nomographs have been developed showing the beam radiation collection efficiency as a function of different sun-collector relative positions with the nondimensional collector length, and base-to-depth ratio of the V-groove collector as parameter. The nondimensional lengths selected are based upon the most commonly available collector module sizes. Ray tracing technique is used for the evaluation of beam radiation augmentation. Only the direct component of solar radiation is treated in the investigation. However, to determine the effect of reflectors on the diffuse radiation interception, methodology of Dale et al. (1981) or Bannerot and Howell (1977, 1979) or Grimmer et al. (1978) can be followed. G.R.

A82-23393 Durability of porous silica antireflection coatings for solar collector cover plates. K. J. Cathro, D. C. Constaole and T. Solaga (Commonwealth Scientific and Industrial Research Organization, Div. of Mineral Chemistry, Melbourne, Australia). *Solar Energy*, vol. 27, no. 6, 1981, p. 491-496. 16 refs. Research supported by the National Energy Research Development and Demonstration Council.

A82-23395 Performance and economics of annual storage solar heating systems. S. Sillman (Solar Energy Research Institute, Golden, CO). *Solar Energy*, vol. 27, no. 6, 1981, p. 513-528. 16 refs. Research supported by the U.S. Department of Energy.

Annual storage is a means of both improving the technical efficiency of active solar systems by allowing solar heat to be collected in summer, and extending the capability of active solar systems to meet nearly 100 per cent of the load. Annual storage systems rely on a large storage tank which usually uses water as the storage medium. The winter load is met partly from day-to-day collection of solar heat, as in a conventional active solar heating system, and partly from heat stored during the summer. A description is presented of the findings from a study of the design trade-offs in annual storage systems, giving particular attention to the trade-off between collector and storage sizes. It was found that system performance increases linearly as storage volume is increased up to the point of 'unconstrained operation' where the storage tank is large enough to store all heat collected in summer. 'Unconstrained operation' is the likely economic optimum. G.R.

A82-23397 * New technologies for solar energy silicon - Cost analysis of dichlorosilane process. C. L. Yaws, K.-Y. Li, T. C. T. Chu (Lamar University, Beaumont, TX), C. S. Fang (Southwestern Louisiana, University, Lafayette, LA), R. Lutwack, and A. Briglio, Jr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Solar Energy*, vol. 27, no. 6, 1981, p. 539-546. 46 refs. Research supported by the U.S. Department of Energy and NASA.

A reduction in the cost of silicon for solar cells is an important objective in a project concerned with the reduction of the cost of electricity produced with solar cells. The cost goal for the silicon material is about $14 per kg (1980 dollars). The process which is currently employed to produce semiconductor grade silicon from trichlorosilane is not suited for meeting this cost goal. Other processes for producing silicon are, therefore, being investigated. A description is presented of results obtained for the DCS process which involves the production of dichlorosilane as a silicon source material for solar energy silicon. Major benefits of dichlorosilane as a silicon source material include faster reaction rates for chemical vapor deposition of silicon. The DCS process involves the reaction 2SiHCl3 yields reversibly SiH2Cl2 + SiCl4. The results of a cost analysis indicate a total product cost without profit of $1.29/kg of SiH2Cl2. G.R.

A82-23399 Simplified method for predicting photovoltaic array output. D. L. Evans (Arizona State University, Tempe, AZ). *Solar Energy*, vol. 27, no. 6, 1981, p. 555-560. 10 refs. Research supported by the U.S. Department of Energy.

A simplified procedure for predicting the long term, monthly average electrical output of photovoltaic arrays is presented. It is restricted to passively cooled, max-power tracked arrays, but is applicable to both south facing, fixed flat arrays and 2-D tracked concentrators. The procedure combines basic parameters characterizing the array with the local monthly mean temperature and the monthly Kt (ratio of the total radiation on the horizontal to the extraterrestrial radiation) to yield a monthly average array efficiency which, when multiplied by the monthly array insolation gives the electrical energy output. (Author)

A82-23575 Spray-deposited black nickel selective absorber surfaces for solar thermal conversion. M. Madhusudana and H. K. Sehgal (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 10, Jan. 1982, p. 65-74. 8 refs.

A low cost, single-step process employing spray pyrolysis has been developed to deposit selective black nickel coatings on commercially available aluminium and galvanised iron substrates. Parameters for growth have been optimised by a comparative study of the structural, optothermal and optical properties of these films. Optimised films of black nickel on aluminium have alpha = 0.92 and emittance (100 C) = 0.14 whereas those on galvanised iron have alpha = 0.90 and emittance (100 C) = 0.13. The films are seen to be extremely adherent to the substrates and to have stable operational characteristics under temperature cycling up to 280 C in low humidity environments. (Author)

A82-23654 # Evaluation of reliability of operational solar-energy systems. J. Mavec, R. Wolosewicz (Argonne National Laboratory, Argonne, IL), and E. Waite (Argonne National Laboratory, Idaho Falls, ID). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 104, Feb. 1982, p. 41-45. 9 refs. Research supported by the U.S. Department of Energy.

This paper presents a reliability study of two solar-energy systems using air as the heat-transfer medium. Failure modes and effects analysis are used to examine the controls of the systems for three operating modes. Principal components are identified for each mode, and a fault tree and reliability block diagram are constructed to structure the fault or failed sequence. Established failure rates are assigned to each component, and an exponential failure distribution is assumed. For components operating on demand at a given average frequency, the adjusted demand and normal operating failure rates are combined to reflect the total contribution. Representative operational times and component frequencies are found for each operating mode. A fault-tree computer code is used to determine minimal outsets to the top event, remove redundant events, and perform necessary calculations. The computer code obtains results at each level (component, cutset, and tree) using repairable and nonrepairable models. (Author)

A82-23656 # Performance of a parallel solar heat pump system. A. F. G. Bedinger, J. Tomlinson, R. L. Reid, and D. J. Chaffin (Tennessee, University, Knoxville, TN). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 104, Feb. 1982, p. 52-55. Research supported by the Tennessee Valley Authority.

The equipment, operations, operating parameters, and performance of a solar heat pump/resistance heated thermal storage bed house heating system are reported. A set of 12 solar air flat plate collectors is mounted on the roof for house heat when solar energy is available, and further heating is available from a heat pump system, with supplemental energy furnished by a limestone pebble storage tank which is charged by 15 kW resistance heating during off-peak hours. Data is provided for one winter's operation, with an analysis for combined and paired or single system performance as opposed to purchased power for a back-up conventional heating system and the power necessary to run the compressors, heating coils, and fans. An additional simulation was devised to be measured against the recorded performance. Significant energy conservation capability was observed for the solar augmented heat pump system without off-peak capability. M.S.K.

A82-23659 * # Heat transfer from combustion gases to a single row of closely spaced tubes in a swirl crossflow Stirling engine heater. C. P. Bankston and L. H. Back (California Institute of Technology, Jet Propulsion Laboratory, Energy and Materials Research Section, Pasadena, CA). *ASME, Transactions, Journal of Heat Transfer*, vol. 104, Feb. 1982, p. 55-61. 9 refs. Research sponsored by the U.S. Department of Energy and NASA.

This paper describes an experimental program to determine the heat-transfer characteristics of a combustor and heat-exchanger system in a hybrid solar receiver which utilizes a Stirling engine. The

system consists of a swirl combustor with a crossflow heat exchanger composed of a single row of 48 closely spaced curved tubes. In the present study, heat-transfer characteristics of the combustor/heat-exchanger system without a Stirling engine have been studied over a range of operating conditions and output levels using water as the working fluid. Nondimensional heat-transfer coefficients based on total heat transfer have been obtained and are compared with available literature data. The results show significantly enhanced heat transfer for the present geometry and test conditions. Also, heat transfer along the length of the tubes is found to vary, the effect depending upon test condition. (Author)

A82-23700 **Photovoltaics - Down to earth at last.** J. R. Burke (Solar Energy Research Institute, Golden, CO). *Sun at Work in Britain*, no. 12-13, 1981, p. 30-38.

The growth of terrestrial applications of solar cells is examined, with attention paid to the cost, materials, and fabrication methods now in existence. Current prices are the $10,000/kW range, with U.S. government research goals intending a reduction to less than $1000/kW by 1986. Solar Energy Research Institute studies are pursuing production cost decreases through a reduction in the number of required manufacturing steps. Efforts to directly electrochemically reduce quartz to solar-grade Si are outlined, as are the development of Si sheet manufacturing methods using porous carbon substrates or graphite filaments capped by a seed. Polycrystalline materials offer cost reductions through the acceptance of many crystals in the cells instead of a monocrystalline configuration, and hydrogenation or casting methods have reduced parasitic power losses caused by recombinations along the grain boundaries. M.S.K.

A82-23703 * **Space platforms - A cost effective evolution of Spacelab operation.** A. J. Stofan (NASA, Office of Space Science, Washington, DC). *(International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980.) Acta Astronautica*, vol. 8, Nov.-Dec. 1981, p. 1299-1310. 7 refs.

The capabilities added to the Shuttle/Spacelab configuration by the addition of the Power Extension Package (PEP), the Power System (PS), and the Science and Applications Space Platforms (SASP) are reviewed with an emphasis on SASP. SASP are intended for placement in orbit by the Shuttle to test new instruments and systems, for clustering of instrumentation, and for servicing, refurbishment, repair, or augmentation by the Shuttle. The PEP permits extended stays in orbit (30 days), and the PS is an orbital solar array and energy storage system acting as a free flying spacecraft. The Shuttle can deliver payloads to the PS or attach to it for extension of the Spacelab operations. Applications of SASP for long term space-based biological experiments are outlined, and the fact that SASP do not increase the required Shuttle in-orbit time is stressed. M.S.K.

A82-23788 **Charge collection microscopy on p-WSe2 - Recombination sites and minority carrier diffusion length.** H. J. Lewerenz, S. D. Ferris, C. J. Doherty, and H. J. Leamy (Bell Telephone Laboratories, Inc., Murray Hill, NJ). *Electrochemical Society, Journal*, vol. 129, Feb. 1982, p. 418-423. 34 refs.

Charge collection microscopy of the layered semiconductor WSe2 is reported. Steps on the surfaces of layered material, bulk dislocations, and growth irregularities are identified as recombination sites. The minority carrier diffusion length perpendicular to the layer structure is determined to be 1.6 + or - 0.2 microns on a smooth surface. The results demonstrate a correlation between step-like surface structures and loss of current collection efficiency in solar energy-converting devices made from layered semiconductors. (Author)

A82-23818 **Thermodynamics of solar collectors (Zur Thermodynamik des Solerkollektors).** F. Bosnjakovic (Stuttgart, Universität, Stuttgart, West Germany). *Brennstoff-Wärme-Kraft*, vol. 33, Oct. 1981, p. 425, 426. In German.

A82-23872 **Second-stage CEC concentrator.** E. M. Kritchman (Chicago, University, Chicago, IL). *Applied Optics*, vol. 21, Feb. 15, 1982, p. 751-754. 5 refs.

The employment of a second-stage compound elliptical concentrator (CEC) designed from the principles of nonimaging optics has been proposed for the enhancement of the concentrating capability of a point focus solar concentrator and for the partial compensation of its nonideal behavior. The CEC is to be installed just behind the focal plane of the first (or primary) concentrator. Operational conditions for a 2-D and a 3-D case are considered, and an investigation based on the use of a ray tracing technique is conducted. Despite its skew-ray loss, the 3-D combination of a paraboloidal primary and a CEC second stage was found to be an almost ideal concentrator. For high reflectances the CEC two stage shows even higher efficiency than the trumpet two stage, especially for lower-grade primaries. G.R.

A82-24019 # **Second-generation parabolic trough solar energy systems optimization analysis.** R. R. Peters (Sandia National Laboratory, Albuquerque, NM). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 147-154. 8 refs. Research supported by the U.S. Department of Energy.

In the near future high-efficiency, low-cost, parabolic trough collectors will probably become available. The economic feasibility of these parabolic trough solar-energy systems is affected by many parameters which include component cost, load shape, fraction of the load supplied by solar energy, average temperature of the collector field and its axis of rotation, and for solar Rankine cogeneration systems, the electrical-to-thermal energy output ratio. The sensitivity of economic feasibility and system design to changes in these and other relevant parameters is discussed. System design and economics generally were found to be sensitive to component cost. They were also found to be quite sensitive to some of the other parameters in restricted ranges. (Author)

A82-24101 **Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.** Conference sponsored by the Commission of the European Communities. Edited by W. Palz (Commission of the European Communities, Brussels, Belgium). Dordrecht, D. Reidel Publishing Co., 1981. 1178 p. In English and French. $81.50.

The materials, design, fabrication, testing, applications, and instrumentation of solar cells and solar cell systems were discussed. Goals, markets, and obstacles in the near and medium term were examined, as were applications in developing countries, methods of cost reductions, and the development of Si and cell module production systems. Alternate materials were investigated for the cells, along with concentrator devices and systems, and current installations were reviewed. Attention was given to advanced systems and future applications, to cell processing, ion implantation, and testing and standards, and the implementation of CdS, amorphous Si, and MIS solar cells was explored. Fundamental work on solar cells was outlined, in conjunction with specific cells in concentrator conditions. M.S.K.

A82-24102 **Sunshine Project solar photovoltaic program and recent R & D activities in Japan.** Y. Hamakawa (Osaka University, Toyonaka, Japan). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 22-29. 38 refs.

A82-24103 **Photovoltaic activities and its applications in China.** Y.-Z. Wei, X.-W. Li, Y. Lie, W.-Z. Li, and P.-N. Yu (Tianjin Institute of Power Sources, Tianjin, People's Republic of China). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 66-70.

A82-24104 **U.S. photovoltaic application experiments and market development.** H. L. Macomber (MONEGON, Ltd., Gaithersburg, MD). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 71-78.

A82-24105 U.S. Department of Energy collector cost reduction program. L. M. Magid (U.S. Department of Energy, Div. of Photovoltaic Energy Systems, Washington, DC). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 158-165.

A program conducted by the United States Department of Energy that focuses on the basic research and technology development required to reduce the price of photovoltaic collectors is reviewed. Analysis of the current status of the flat-plate and concentrating collectors and projected status of the photovoltaic collector cost reduction efforts, both for flat-plate and concentrating collectors indicates that the photovoltaic industry should easily be able to meet the 1982 goal of $2.80/Wp collectors. Significant progress is also apparent toward the longer-range $0.70/Wp and $0.15-0.40/Wp goals. V.L.

A82-24106 The solar material market - Projections, needs and commitments. W. Freiesleben (Wacker-Chemitronic GmbH, Burghausen, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 166-170.

A82-24107 A strategy for cost reduction from the point of view of a French industrialist (Stratégie de réduction des coûts point de vue d'un industriel français). J. P. Gomis (Photowatt International, S.A., Argenteuil, Val-d'Oise, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 171-177. In French.

Strategies for improving the cost-performance of solar cell modules, the cells, and applications systems are reviewed, along with a summary of current research and development goals and procedures. Research is noted to concentrate intensive work on a particular cell type, on mass production methods, or to cover all methods and materials possible, and then proceed forward with all candidates showing equal promise. Noting that the DOE goals for commercially-ready prices in 1986 rest on a fall in the cost of high grade silicon, on mass production, and a projected life of 20 yr, efforts to optimize the production steps are indicated. Savings are noted to be possible in all facets of module construction, and optimization studies are recommended for coupling the solar systems to different loads for different purposes. M.S.K.

A82-24108 Industrialization of photovoltaics. J. Lindmayer (Solarex Corp.; Semix, Inc., Rockville, MD). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 178-185.

The technological, economical, and financial aspects of the industrialization of photovoltaics are briefly reviewed. Topics discussed include the role of photovoltaics in general energy production, research and development efforts, financial resources available for industrial development, marketing policies, sources of raw material, and applications. V.L.

A82-24109 Research on photovoltaic conversion - A guarantee of efficiency for the European solar energy program. M. Rodot (CNRS, Paris, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 186-193. 30 refs.

Research goals in the field of photovoltaic conversion are discussed with emphasis on the silicon material problem and the architecture of photovoltaic generators. Consideration is given to the optimal use of photovoltaic generators in the context of specific applications, integration of solar cells and storage systems, and relation between photovoltaic research and photochemical-photobiochemical research. Mansgerial and organizational problems in European photovoltaic research and development are also briefly discussed. V.L.

A82-24110 Research options as seen from U.S.A. J. J. Loferski (Brown University, Providence, RI). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 194-198. 12 refs.

Current work, and in particular theoretical research, in the area of new cell designs and tandem cells is reviewed. Three main directions of research are identified. These are: (1) improvement of solar cell efficiency by design modifications such as incorporation of minority-carrier mirrors and optical mirrors; (2) development of super-efficiency single crystal solar cells by resort to tandem solar cell systems consisting of stacks of individually optimized cells with minority-carrier and optical mirrors; and (3) development of thin film cells with the use of minority-carrier and optical mirrors. V.L.

A82-24111 Photovoltaic R&D program overview. D. L. Feucht (Solar Energy Research Institute, Golden, CO). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. D. Reidel Publishing Co., 1981, p. 199-203. 25 refs.

The current status of a research and development program conducted under contract to the U.S. Department of Energy to develop low cost solar cells ($0.15-0.40/Wp modules in 1980$) is reviewed. The emphasis of the program is on thin film and electrochemical cells with conversion efficiencies greater than 10% and multijunction cells with conversion efficiencies greater than 30%. The R&D efforts include research on polycrystalline silicon, amorphous materials, cadmium sulfide cells, gallium arsenide cells, emerging materials, and advanced concentrator and cell concepts. V.L.

A82-24112 * A U.S. view of silicon production processes. R. Lutwack (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 220-227. Research sponsored by the U.S. Department of Energy and NASA.

One of the objectives of the Low-Cost Solar Array Project is the demonstration of the practicality of processes for producing silicon, suitable for fabricating solar cells for terrestrial applications, at prices less than $14/kg. Approaches being investigated are related to a metallurgical silicon/silane/silicon process, a metallurgical silicon/dichlorosilane/Siemens-type process, and a silicon tetrachloride-zinc reduction process. There is a great probability that the first process will yield semiconductor grade Si at a price less than $14/kg. The second process appears to be capable of providing polysilicon with a purity equivalent to the present commercial semiconductor grade silicon at a price of about $20/kg. An important part of the program is the investigation of the effects of impurities on the performance of solar cells. G.R.

A82-24113 * Progress toward goals in silicon sheet development. K. M. Koliwad and M. H. Leipold (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 228-235. 5 refs. Research supported by the U.S. Department of Energy; Contract No. NAS7-100.

One of the goals of the national photovoltaic program in the U.S. is the establishment of an industry producing photovoltaic material which can be sold at a price not exceeding $0.70/W by 1986. A key element concerning the achievement of this goal is the development and utilization of improved methods for producing silicon sheet. Specific technologies being investigated in this connection can be divided into two categories. Methods of one category are based on a utilization of sheet growth techniques including film-fed growth, dendritic web, and silicon-on-ceramic processes. The approaches used by methods of the second category involve ingot and wafering processes, including Czochralski growth, the heat exchanger method, multiblade procedures, and the use of a fixed abrasive multiwire. It is found that using $84/kg silicon, most sheet technologies would yield module prices in the $2.00/Wp to $3.00/Wp range. G.R.

A82-24114 **The Wacker approach to low-cost silicon material technology.** E. Sirtl (Heliotronic GmbH, Burghausen, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 236-243. 11 refs. Research supported by the Bundesministerium für Forschung und Technologie.

Proprietary, long-term materials research programs concerned with processes having high cost/energy-saving potential for the production of high-purity solar cell silicon are discussed. Program goals include the development of rugged, high-throughput rate production equipment, and impurity handling, or defect engineering standards, which will yield photovoltaic solar energy conversion efficiencies of a minimum of 10%. Different starting materials for a variety of low-cost crystallization techniques, the machining and slicing of silicon, and such diagnostic techniques as topographic methods, multielement analysis, identification of point defects, and photovoltaic evaluation, are discussed. O.C.

A82-24115 **Ribbons and sheets as an alternative to ingots in solar cell technology.** E. Fabre and C. Belouet (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 244-251. 30 refs.

Silicon sheet-shaping techniques which rely on meniscus-controlled growth are presented, and their characteristics are discussed in the scope of their economic competitiveness against the Czochralski growth for a mass production of low-cost solar cells. The current achievement differs in most of the processes, which may be due to differences in their respective maturity and level of effort, rather than in their ultimate potentialities. The dendritic WEB technique is found to have high efficiency and low throughput, and in the long range, the processes are expected to yield shaped materials with similar photovoltaic characteristics which will be an economic alternative to ingot technologies. The RAD growth technique is also discussed. D.L.G.

A82-24116 **Directional solidification of MG silicon by Heat Exchanger Method /HEM/ for photovoltaic applications.** F. Schmid, M. Basaran, and C. P. Khattak (Crystal Systems, Inc., Salem, MA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 252-256. 19 refs. Contract No. XS0-9171-1.

A82-24117 **Advances in silicon solar cell processing.** R. J. Van Overstraeten (Leuven, Katholieke Universiteit, Heverlee, Belgium). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 257-262. 16 refs.

The various technologies that are used or are under study in solar cell production are reviewed with emphasis on technologies compatible with a cost objective of $1 per peak watt. The discussion includes analysis of the design parameters based on the physics of the cells as well as the various processing steps, such as surface preparation, front junction formation, low-high junction formation for a back surface field, formation of front and back ohmic contacts, elimination of edge effects, and application of an antireflective coating. The specific objectives and criteria for every processing step are discussed and the most viable processes are identified. V.L.

A82-24118 **Comparison of solar cells from nonsingle and single crystalline silicon in a pilot production line.** K. Roy and W. Pschunder (Telefunken AG, Heilbronn, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 263-269. Research supported by the Bundesministerium für Forschung und Technologie.

An economical process has been developed for the production of solar cells for terrestrial application from low-cost cast polycrystalline silicon. The process makes it possible to produce 10 x 10 cm cells with conversion efficiencies of 9-10%, as compared with 12-13% for single-crystal cells, with yields as high as for single-crystal silicon. Ways to further optimize the process are discussed. V.L.

A82-24120 * **Low-cost solar array project progress and plans.** W. T. Callaghan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 279-286. Research sponsored by the U.S. Department of Energy.

The considered project is part of the DOE Photovoltaic Technology and Market Development Program. This program is concerned with the development and the utilization of cost-competitive photovoltaic systems. The project has the objective to develop, by 1986, the national capability to manufacture low-cost, long-life photovoltaic arrays at production rates that will realize economies of scale, and at a price of less than $0.70/watt. The array performance objectives include an efficiency greater than 10% and an operating lifetime longer than 20 years. The objective of the silicon material task is to establish the practicality of processes for producing silicon suitable for terrestrial photovoltaic applications at a price of $14/kg. The large-area sheet task is concerned with the development of process technology for sheet formation. Low-cost encapsulation material systems are being developed in connection with the encapsulation task. Another project goal is related to the development of economical process sequences. G.R.

A82-24121 **Photovoltaic testing in the European communities.** K. H. Krebs and E. Rossi-Gianoli (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 287-292.

The facilities and testing procedures for establishing the viability of solar cells as an energy source and standards for testing and use in the European community are described for the case of the Ispra ESTI installation. Testing is carried out to determine new device performance in relation to proven devices and production methods. Because the photovoltaics industry is in its infancy, tests are functional instead of prescriptive, and indoor testing is used to verify manufacturer's performance claims, and to achieve durability under specified stress levels. Trials are also performed with solar cell modules to verify continued operation and integrity under severe environmental conditions, with projections of useful life of 10 yr. The durability is noted to be crucial to guaranteeing a satisfactory energy payback. M.S.K.

A82-24122 **The development of amorphous silicon solar cells.** W. E. Spear (Dundee, University, Dundee, Scotland). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 302-308. 24 refs. Research supported by the Commission of the European Communities.

The short circuit current is considered in a discussion of the limits of achievable conversion efficiency set by the electronic properties of presently available materials in developing amorphous silicon cells. Photogeneration and geminate recombination are discussed, and lifetime measurements on p-i-n junctions are made to show that the collection region is determined by the hole drift distance. The mechanism of hole transport and the possibility of improving it are considered, and it is concluded that volume recombination provides the main limitation in current a-Si cells. D.L.G.

A82-24123 **Development of amorphous Si solar cells in Japan.** Y. Kuwano and M. Ohnishi (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 309-318. 39 refs. Research supported by the Agency of Industrial Science and Technology.

The development of a-Si solar cells in Japan is reviewed with discussions on fabrication techniques, cell structures, and perfor-

mances of a-Si solar cells. Recent advances in the field are characterized by conversion efficiencies of 3.4-5.2% for a-Si:H, and 1.3-2.7% for a-Si:F:H, both of which are on small cells of not greater than about 1 sq cm. Large area cells up to 10 x 10 sq cm have been developed with conversion efficiencies of up to about 3.6%. New types of high output voltage photovoltaic devices have also been developed, which are constructed of multilayered and cascade-type solar cells. D.L.G.

A82-24124 Post-hydrogenation of CVD amorphous silicon - A promising preparation process for solar cells. N. Szydlo, D. Kaplan, and R. Poirier (Thomson-CSF, Laboratoire Central de Recherches, Orsay, Essonne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 317-321. 7 refs.

Properties of Si solar cells prepared by CVD with a low hydrogen content and subsequent treatment in a hydrogen plasma to add a controlled amount of hydrogen are reviewed, along with a study of the mechanisms of carrier collection in Schottky barrier cells. Phosphorus doping was accomplished by means of its addition in the silane gas mixture, and precisely controlled hydrogenation yielded higher cell efficiencies than undoped glow-discharge produced cells, although the optical absorption was not significantly altered. A correlation was found in undoped layers between the carrier collection length and space charge width. The quantum yield was independent of doping and applied negative bias. No evidence was observed of a strong electric field dependence in the Schottky barrier structures, implying that carrier mobility and/or built-in electric fields induced separation of the hole pairs. M.S.K.

A82-24125 Properties of fluorinated amorphous silicon solar cells. M. Moeller, R. D. Plaettner, W. Stetter, and B. Rauscher (Siemens AG, Forschungslaboratorien, Munich, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 322-326. 5 refs. Research supported by the Bundesministerium für Forschung und Technologie.

The photovoltaic performance of hydrogenated-fluorinated, hydrogenated a-Si, Pt-Schottky, MIS, and p-i-n solar cells were compared, along with the effects of dc and RF processes for preparing fluorinated Si solar cells. Increases of 10% in the mole fraction of F were observed after the dc glow discharge over the RF formation of a-Si:F:H cells. An upward shift in the peak intensity by about 60 MeV in the fluorinated cells was concluded to be due to the concentration of F, with a bandgap increase of 0.4 MeV with the mole fraction of F augmented from 1.5-6%. AM1 illumination tests of the cells showed that the Schottky a-Si:F:H cells showed lower short-circuit currents than the a-Si:H cells, with an open-circuit current which could be increased by the formation of an oxide layer after heating in moist oxygen. The a-Si:H p-i-n cells were observed to have properties of long-term stability. M.S.K.

A82-24126 Sprayed cadmium sulphide solar cells. G. A. Roderick (Photon Power, Inc., El Paso, TX). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 327-334.

A spray process for the production of thin-film (5 microns) Cd/Cu(x)S solar cells is discussed and typical results are presented for the resulting cells. Plans for long-term very-large-scale production of cadmium sulfide cells are examined together with projected cost data and basic design criteria. A schematic representation of the cell, spray process, and an I/V curve are given. V.L.

A82-24127 Cu2S-CdS sprayed solar cells. G. Bordure, C. Llinares, J. Bougnot, M. Perotin, H. Luquet, S. Belgacem, and M. Savelli (Montpellier II, Université, Montpellier, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 335-339. 11 refs. Research supported by the Centre National de la Recherche Scientifique and Commission of the European Communities.

Cu2S-CdS solar cells fabricated by spraying and dipping techniques are characterized with respect to their electrical and optical properties. It is shown that the current response of heat treated cells is limited only by the light absorption in Cu2S, with collection efficiency of the junction being close to unity. Losses during treatment and early degradation which are smoothly sensitive to wavelength, are mainly related to the collection efficiency of the junction. Results suggest that the open circuit voltage was the greatest potential for improvement. V.L.

A82-24128 Evaporated CdS-Cu/x/S solar cells. W. H. Bloss, F. Pfisterer, and H.-W. Schock (Stuttgart, Universität, Stuttgart, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 340-347. 8 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4045-B; Commission of the European Communities Contract No. ESC-R-003-D.

Large-area CdS-Cu(x)S solar cells produced by evaporation of CdS and by applying the wet process are discussed with reference to technological procedures and performance characteristics. The I-V curve is presented for a cell with an active area of 42 sq cm. A conversion efficiency of 7.3% has been achieved without using antireflection coatings. A simple procedure for preparing integrated generators, 15 x 30 sq cm, is presented; the generator efficiency of eight cells connected in series amounts to 4%. V.L.

A82-24129 The need for photovoltaic unit operations experimentation. T. W. F. Russell, B. N. Baron, and R. E. Rocheleau (Delaware, University, Newark, DE). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 348-352. 5 refs.

It is shown that unit operations experimentation is necessary for the further development of the photovoltaics industry, and the formulation of a commercial-scale process design for the deposition of cadmium sulfide-copper sulfide solar cell active semiconductor layers is described as an illustration. Coupled heat and mass balance equations were developed to model the evaporation of cadmium sulfide and, after verification at the bench scale, the model was used in the design of a continuous, reel-to-reel vacuum coater for cadmium sulfide deposition. The results of initial experiments with this vacuum deposition unit are presented. O.C.

A82-24130 Operational, reliability, and maintenance experience with photovoltaic concentrator arrays. E. L. Burgess and B. D. Shafer (Sandia National Laboratory, Albuquerque, NM). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 360-367. 11 refs. Research supported by the U.S. Department of Energy.

The status of photovoltaic concentrator technology in the United States is discussed. Operational experience in addition to component reliability and system maintenance are discussed, including the applicable solar thermal concentrator reliability and maintenance experience. Efficiencies have increased from 6-7% to 12% for silicon arrays, and initial data for a gallium arsenide array yield 13-15%. No unsolvable reliability or maintenance problems are expected. D.L.G.

A82-24131 Sun tracking controller for multi-kW photovoltaic concentrator system. R. P. Semma and M. S. Imamura (Martin Marietta Aerospace, Denver, CO). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 375-380.

A two-axis suntracking controller is presented, which is designed to achieve low cost, high performance reliability, and operational flexibility for multi-kW to multihundred-kW photovoltaic concentrator applications. The controller is based on an active sun sensing approach, allows an array assembly to track the sun within five arcmin, and has the capability to stow the array at night or during inclement weather conditions, communicate with an external computer, and provide autonomous operation and diagnostic monitoring. This third generation design represents a significant improvement

over the two earlier generations, which were based on hard-wire logic. D.L.G.

A82-24132 The Sophocle program (Le programme Sophocle). M. Claverie, A. Dupas (CNRS, Paris, France), and D. Esteve (CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes, Toulouse, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 381-390. In French.

The development of a standardized tracking and concentrating solar cell power generating system suitable for industrial production is reviewed. A 1 kW module was fabricated for Si cells under 45 suns concentration, and with a cooling system to maintain cell efficiency. Fresnel lenses provide the concentration, and tracking is accomplished on an altazimuth tracking stand, which limits the area of capture to 50 sq m, corresponding to about 5 kW. Characteristics of the system include 4 sq cm Si solar cells, concentration efficiencies of 75 percent, surface areas ranging from 6-50 sq m, tracking accuracy to within 4 mrad, and natural convective cooling over an aluminum trough with channeled sides. Units have been deployed in India, Algeria, Senegal, Mexico, Brazil, and Gabon to gather operational data. M.S.K.

A82-24133 New concepts for static concentration of direct and diffuse radiation. A. Luque, J. Eguren, J. M. Ruiz, A. Cuevas, J. del Alamo, J. M. Gomez, M. Acuña, and G. Sala (Escuela Técnica Superior de Ingenieros de Telecomunicación, Madrid, Spain). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 396-400.

Rules for casting maximum energy on a cell placed in a static concentrator of minimum entry aperture are derived in an investigation of the feasibility of static concentrators and their operating limits. A concentration of 9.13 is found to be the upper bound for collecting the direct sunbeam throughout the year, and a concentration of 4.5 is the upper bound for collecting diffuse light. A prototype concentrator with bifacial cells is fabricated, which is fully static and accepts a part of the diffuse radiation so that it may be handled in a manner similar to that of a conventional flat panel. A panel efficiency of 9.1 percent is predicted in an improved panel, with a cost estimate for medium size production of $3.19 W/peak. D.L.G.

A82-24134 Advanced concepts for photovoltaic concentration. W. H. Bloss, M. Griesinger, and E. R. Reinhardt (Stuttgart, Universität, Stuttgart, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 401-407. 6 refs.

A dispersive concentrating system is presented, which is based on phase holograms exhibiting only minimum absorption, and allows high concentration and simultaneous splitting of the spectral regions. Local hardening effects can be achieved by spatial variation of high light intensity in dichromated gelatin films on glass substrates, which leads to optical density profiles and results in a selective Bragg reflection at direct illumination. The diffraction efficiency and the spectral sensitivity of these transmission volume holograms are described. Efficiencies of over 30% can be obtained in connection with different solar cell systems matched to the spectral regions. D.L.G.

A82-24135 Growth and characterization of cascade solar cells. S. M. Bedair, M. L. Timmons, and M. Simons (Research Triangle Institute, Research Triangle Park, NC). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 408-412. 6 refs. Research supported by the U.S. Department of Energy.

Monolithic, two-junction cascade solar cells are fabricated in two different III-V materials systems: Al-Ga-As and Al-Ga-As-Sb. The Al-Ga-As system employs a GaAs low bandgap cell and a 1.9 eV AlGaAs high bandgap cell connected by an AlGaAs tunnel junction, and although the cell does not possess the optimum bandgap values for maximum efficiency, it is attractive from a developmental standpoint since it employs a proven materials system closely lattice matched throughout its compositional range. The Al-Ga-As-Sb system offers an optimum bandgap combination for concentrator applications, although experimental devices suffer from a low open circuit voltage problem. D.L.G.

A82-24136 On the conversion of solar radiation with fluorescent planar concentrators /FPCs/. A. Zastrow, K. Heidler, R. E. Sah, V. Wittwer, A. Goetzberger (Fraunhofer-Institut für angewandte Festkörperphysik, Freiburg im Breisgau, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 413-417. 14 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4190-A.

The utilization of infrared fluorescent dyes in fluorescent planar concentrators is discussed in an investigation of 30 infrared laser dyes. It is shown theoretically that quantum yields and stability will be lower in the infrared region than in the shorter wavelength region. The quantum yields of fluorescence may depend strongly on solvent viscosity and temperature in several cases, and since solvent viscosity also decreases with increasing temperature, the degradation of efficiency may be due to change in viscosity more likely than to change in temperature. The suppression of radiationless processes by deuteration of NH2-groups in oxazine dyes significantly enhances quantum yields. D.L.G.

A82-24137 Measurement of the spectral response of silicon solar cells under highly illuminated conditions. B. C. Chambers and C. E. Backus (Arizona State University, Tempe, AZ). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 418-422. U.S. Department of Energy Contract No. 49-1510.

In an investigation of the behavior of photovoltaic devices under concentrated sunlight, the spectral response of several silicon solar cells was measured under illumination levels varying from approximately 1 mW/sq cm to 12,500 mW/sq cm for 11 wavelengths distributed over the solar spectrum. The spectral response was found to increase with increasing concentration for each of the wavelengths, and the spectral response for the shorter wavelengths increased by 1-40% while the response increased by 4-90% for the longer wavelengths. It is concluded that the filling of recombination centers with increased illumination could result in increasing the observed current output. D.L.G.

A82-24138 Solar energy applications in telecommunications (Les applications de l'énergie solaire dans les télécommunications). J. Girard (CNET, Issy-les-Moulineaux, Hauts-de-Seine, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 424-434. In French.

The results of a half-decade of a coupled wind-photovoltaic powered, remotely sited telecommunications installation called 'Aerosolec' are reported. A station is examined which was situated at 500 m altitude between Nice and Monaco and comprised a 4 module solar cell plant generating 180 W, a 300 W windpowered generator, and a battery bank. The batteries were linked by a diode, charged by the photovoltaics only when load was met, and provided voltage when the wind/solar cell configuration failed to produce enough power to meet demand. Output of the generators and meteorological parameters were recorded for two years. The station drew a nominal 180W, which was met by the power systems, and involved an actual extra discharge of excess energy. Other, similar stations are outlined, and the use of coupled wind/solar systems for telephone service in remote sites, for optic fiber repeaters, and for telephone relay station are recommended. Cost advantages are seen with the solar/wind systems over liquid hydrocarbon fueled generator systems for low power demand installations. M.S.K.

A82-24139 Experience acquired in the field of low power photovoltaic application to educational television. Y. Houssin (Bureau Yves Housin, Paris, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference,

Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 435-438.

Low-power photovoltaic applications in certain African regions lacking electrification are discussed in an investigation to determine the extent of silicon surface required for various geographical areas. Experience acquired in Africa using solar energy for the power supply of audiovisual receivers is discussed. A definition of the best performing equipment with the lowest power consumption is obtained, taking maintenance into consideration. A high level of reliability has been reached with, for example, an average breakdown of less than 1 unit every two years for the 20,000 television receivers installed in the Ivory Coast. D.L.G.

A82-24140 The application of photovoltaics to water pumping and irrigation in Africa. B. Verspieren (Société Mali Aqua Viva, San, Mali). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 439-445. In French.

A82-24143 * Survey of residential and intermediate photovoltaic applications. J. L. Hesse (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 498-504. Research sponsored by the U.S. Department of Energy and NASA.

The construction and operation of residential and intermediate size photovoltaic power systems as performed by the DOE Photovoltaics Program are reviewed. The program is directed toward the development of economically competitive, commercially available, photovoltaic power systems to provide safe and reliable energy for a wide range of applications. Systems which are currently operational or in construction range in size from 5 kWp to 225 kWp, and real-world testing is being pursued with residential, industrial, institutional, and commercial systems to establish their feasibility and readiness for commercialization. D.L.G.

A82-24144 Analysis of a 60 kW photovoltaic power plant after the first year of operation. D. J. Roesler (U.S. Department of Energy, Washington, DC), D. D. Faehn (U.S. Army, Mobility Equipment Research and Development Command, Fort Belvoir, VA), and L. R. Suelzle (Helionetics, Inc., San Diego, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 505-512.

The performance of the 60 kW photovoltaic system at Mt Laguna Air Force Station was analyzed after the first year of operation. The 60 kW system met or exceeded nearly all of the technical requirements originally established, generating nearly 100,000 kWh and operating about 3400 hours. The downtime was extremely low, and a 16% reduction in maximum available power of the array was experienced, which is attributed to module engineering problems. All observations to date support the belief that a dc-ac photovoltaic energy conversion system without on-site energy storage can effectively augment a utility grid, even in a remote location. D.L.G.

A82-24145 Photovoltaic pilot projects in the European community. F. C. Treble, G. Grassi, and W. Schnell (Commission of the European Communities, Brussels, Belgium). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 513-520.

The paper presents proposals received for the construction of photovoltaic pilot plants as part of the Commission of the European Communities' second 4-year solar energy R and D program. The proposed plants range from 30 to 300 kWp and cover a variety of applications including rural electrification, water pumping, desalination, dairy farming, factories, hospitals, schools and vacation centers. Fifteen projects will be accepted with a total generating capacity of 1 MWp, with preference given to those projects involving the development of new techniques, components and systems. D.L.G.

A82-24146 Photovoltaics in the context of off-grid small power systems. A. Gabriel (Shell International Petroleum Co., Ltd., London, England) and A. W. De Ruyter Van Steveninck (Shell International Petroleum Maatschappij, The Hague, Netherlands). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 521-525.

Practical criteria which determine the cost effectiveness in different applications of stand-alone off-grid continuous power systems up to 20 kW are examined. The analysis is limited to systems based on internal combustion engines and photovoltaic systems. It is shown that for nonmobile continuous power systems with offtakes above 20-25%, photovoltaic cost parity with 5 kW diesel systems is expected to occur in the second half of this decade or in the first half of the next decade, depending mainly on the fuel cost to the consumer. Larger diesel systems show improved costs due to scale benefits which are not available to photovoltaic systems. V.L.

A82-24147 A 50 kW photovoltaic power plant coupled to the 15000 V electricity grid. J. L. Chenon and D. J. Denis (Société d'Optique, de Mécanique, d'Electricité et de Radio, Argenteuil, Val-d'Oise, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 526-530.

Plans and components for providing prototype photovoltaic power plants to several Greek islands are discussed. The systems will produce 50 kW, with power conditioning for interconnection with submarine cable supplied grid power or with battery storage where no interconnection exists. The plants will comprise 1500 modules, each producing 33 W, with seasonal adjustment of the tilt angle of each subarray. Battery storage, where necessary, will contain 250 kWh, and the 50 kW power output of the plants is intended to in every case be less than the power required by the users. It is noted that wind measurements have also been taken along with insolation data, and future uses of coupled wind/solar installations are indicated. M.S.K.

A82-24148 Hardware simulation of a scaled down photovoltaic power system. R. Weiss and J. Appelbaum (Tel Aviv University, Tel Aviv, Israel). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 531-534.

A state of a photovoltaic power system study intermediate between the computer simulation (software simulation) and the final system realization is proposed. It involves a hardware construction and a real-time operation of a scaled-down system, built with real components that are normally included in a photovoltaic plant. In this way, detection and correction of system operation problems can be allowed for in the final full-scale design. Simulation and scaled down system operation contribute to the photovoltaic system design knowledge and complement each other. C.R.

A82-24149 Status of the German terrestrial photovoltaic activities. R. Koepke and K. Ullrich (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 538-540.

The budget, laboratories involved, and research and development areas of the West German photovoltaic activities are outlined. Government funding extraneous to universities and private industry totaled 27.3 million Deutche marks in 1979, with 80% of the funds devoted to Si cell development and applications. The formation of amorphous Si cells was explored in terms of glow discharge, plasma deposition, and CVD methods. Unconventional cells such as CdSe-MIS, Cu2O/ZnO, Zn3P2, and WSe2 cells have been investigated, along with fluorescent concentrators, polycrystalline Si wafers, as well as production line prototype CdS/Cu2S thin film solar cells. M.S.K.

A82-24150 * Current status of solar cell performance of unconventional silicon sheets. H. I. Yoo (Applied Solar Energy

Corp., City of Industry, CA) and J. K. Liu (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 548-552. NASA-supported research.

It is pointed out that activities in recent years directed towards reduction in the cost of silicon solar cells for terrestrial photovoltaic applications have resulted in impressive advancements in the area of silicon sheet formation from melt. The techniques used in the process of sheet formation can be divided into two general categories. All approaches in one category require subsequent ingot wavering. The various procedures of the second category produce silicon in sheet form. The performance of baseline solar cells is discussed. The baseline process included identification marking, slicing to size, and surface treatment (etch-polishing) when needed. Attention is also given to the performance of cells with process variations, and the effects of sheet quality on performance and processing. G.R.

A82-24151 * Multiple EFG silicon ribbon technology as the basis for manufacturing low-cost terrestrial solar cells. B. Mackintosh, J. P. Kalejs, C. T. Ho, and F. V. Wald (Mobil Tyco Solar Energy Corp., Waltham, MA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 553-557. 5 refs. Contract No. JPL-954355.

Mackintosh et al. (1978) have reported on the development of a multiple ribbon furnace based on the 'edge defined film fed growth' (EFG) process for the fabrication of silicon ribbon. It has been demonstrated that this technology can meet the requirements for a silicon substrate material to be used in the manufacture of solar panels which can meet requirements regarding a selling price of $0.70/Wp when certain goals in terms of throughput and quality are achieved. These goals for the multiple ribbon technology using 10 cm wide ribbon require simultaneous growth of 12 ribbons by one operator at average speeds of 4 to 4.5 cm/min, and 13% efficient solar cells. A description is presented of the progress made toward achieving these goals. It is concluded that the required performance levels have now been achieved. The separate aspects of technology must now be integrated into a single prototype furnace. G.R.

A82-24152 Progress in the growth and performance of RAD silicon sheets. C. Belouet, C. Belin, J. Schneider, and J. Paulin (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 558-562. 10 refs. Research sponsored by the Commission of the European Communities and Commissariat à l'Energie Solaire.

Polysilicon sheets up to 6 m in length have been grown continuously by the RAD process on carbon substrates coated with rough laminar polycarbon. The effective diffusion length in as-grown smooth layers reaches a maximum of 60 microns at pulling rates up to 10 cm/min. RAD solar cells with an antireflective coating made from continuous ribbons exhibit AM1 conversion efficiencies above 9 percent. V.L.

A82-24154 * Evaluation of silicon-on-ceramic material for low-cost solar cells. J. D. Zook (Honeywell Corporate Technology Center, Bloomington, MN). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 569-573. 8 refs. Research sponsored by the U.S. Department of Energy and NASA.

The silicon-on-ceramic (SOC) process produces thin layers of silicon on inexpensive ceramic substrates. The layers are produced by unidirectional solidification of molten silicon, and are polycrystalline. Solar cells made from SOC material have performed with a conversion efficiency of 10.5%. In connection with the objective to improve the efficiency of SOC solar cells, an investigation was conducted to assess the relative importance of grain boundaries and impurities. In order to separate the two effects, light-beam-induced current (LBIC) measurements of the short-circuit current were made using a micron-sized light beam from a monochromator. The LBIC measurements are closely related to solar cell performance since the technique identifies the various spatial and spectral contributions to solar cell current. On the basis of the obtained results, it appears that structural defects are more important than chemical defects in limiting the performance of present SOC solar cells. G.R.

A82-24155 Epitaxial growth of silicon by CVD in a hot-wall furnace. J. Bloem, Y. S. Oei, J. Hanssen, and L. J. Giling (Nijmegen, Katholieke Universiteit, Nijmegen, Netherlands). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 574-578.

A new method is proposed for growing epitaxial layers of silicon whereby silicon is deposited from the vapor phase in a reactor placed inside a furnace instead of being heated by an RF coil. The method produces silicon slices of high packing density and is characterized by low energy consumption. Epitaxial growth in a furnace can be realized without any deposition on the reactor walls. V.L.

A82-24157 Characterization of plasma-sprayed silicon layers as possible base material for solar cell fabrication. M. S. Alaee and T. Hashemi (Materials and Energy Research Centre, Teheran, Iran). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 584-588.

Plasma-sprayed silicon films were characterized using X-ray diffractometry, Auger electron spectroscopy, scanning electron microscopy, and secondary ion mass spectrometry. It is shown that plasma spraying of silicon powder makes it possible to obtain reproducible films with controlled thickness and impurity. The films are highly polycrystalline with crystallite sizes up to 100 microns. An attempt has been also made to dope the sprayed film to fabricate a p-n junction. Initial results show that a fairly well defined space-charge region can be formed. V.L.

A82-24160 Study of the elaboration of semicrystalline silicon ingots. J. Fally and C. Guenel (Compagnie Générale d'Electricité, Centre de Recherches, Marcoussis, Essonne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 598-602. Commissariat à l'Energie Solaire Contract No. 78-015.

The formation of semicrystalline Si ingots as a process competitive with ribbon-pulling methods of fabricating solar cells to achieve a 10-fold reduction in the cost of solar cells is described. A thermal gradient is established in a graphite furnace to ensure a directional characteristic in the crystallization. A p-type semicrystalline material is currently achievable using semiconductor-grade Si for the melt, and methods have been devised for reusing the crucible. Grains have a diameter less than 1 mm, while basaltic grains perpendicular to the plane of the wafer are in the 2-3 cm range. The presence of isolated dislocations, lineages, and twins in the grains have contributed to a low efficiency of 8.07 percent thus far although the inclusion of an AR coating is expected to raise the figure to over 10 percent. M.S.K.

A82-24161 * Development of large area, low-cost, solar cell processing sequence. S. Chitre (Photowatt International, Inc., Tempe, AZ) and J. Donon (Photowatt International, S.A., Argenteuil, Val-d'Oise, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 608-614. Contract No. JPL-954265.

A cost effective process based on state-of-the-art technology has been developed for the production of large-area (55 sq cm and larger) solar cells. The process is capable of providing silicon and polysilicon cell efficiencies in excess of 10% at an overall cost of 12 c/watt in 1980 dollars. The process provides large throughputs and is suitable for complete automation with high yields. Various stages of the process development are discussed. V.L.

A82-24164 Optimized diffusion parameters for cells made by columnar silicon. F. Ferrazza, F. C. Matacotta (Genova, Università,

Genoa, Italy), S. Pidatella, and L. Sardi (Ansaldo Elsag /AE/, Genoa, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 625-629. 5 refs.

The behavior of phosphorus in a two-step diffusion process is examined in an investigation to find the best first-step diffusion conditions in order to obtain maximum cell efficiency. Results indicate that at 750 C for 9 h, a deeper junction depth can be made, increasing the dead layer and obtaining cells with over 12.5 percent efficiency. Lifetime and EBIC measurements show good correlation with short circuit current values by obtaining lifetime values between 1.1 and 2.8 microns. D.L.G.

A82-24165 Direct coupled microwave thermal processing for photovoltaic device fabrication. D. C. Guidici (Siltec Corp., Menlo Park, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 630-634. Research sponsored by the U.S. Department of Energy.

A microwave thermal processing technology has been developed which reduces cycle time and energy requirements for solar cell manufacture through the direct coupling of a tuned microwave field to the material processed. The microwave processing is shown to be feasible for both junction formation and metallization sintering; cells produced have an efficiency of 8%. Diffusion throughput is satisfactory if multiple wafer processing (coin stacks) is used. Metallization sintering throughput is, however, limited by the single wafer process capability, and another form of applicator would be necessary to make microwave heating economically attractive for this process. V.L.

A82-24167 Effects of special processing on diffusion lengths in polycrystalline silicon solar cells. W. A. Orr, G. Mabilia, and V. Paraggio (Napoli, Università, Naples, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 646-649. 5 refs. Consiglio Nazionale delle Ricerche Contract No. 79,01631,92.

The effects of process parameters on the characteristics of polycrystalline silicon solar cells have been investigated by localized spectral response measurements which permits independent determination of diffusion lengths in the grain bulk and near the boundary. It is found that the n-type prediffusion leads to a reduction in average diffusion length, whereas p-type prediffusion yields longer diffusion lengths in p-type substrates. The results are explained in terms of relative amounts of dopant preferentially diffused into grain boundaries. V.L.

A82-24168 Scanning spectral response measurements of large grain polysilicon solar cells for process optimization. M. Arienzo, A. Muleo (Solaris S.p.A., Florence, Italy), and W. A. Orr (Napoli, Università, Naples, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 650-653.

Solar cells fabricated from bicrystalline silicon wafers with (111) and (100) orientations have been characterized using scanning spectral response measurements with a view to optimize the cell production process. In particular, variations in the quantum yield of the cells with distance from the grain boundary have been analyzed. On the basis of the results obtained, an optimum Al sintering time of 60 sec has been selected. It has also been shown that even in silicon with short diffusion lengths, a BSF can be used to enhance cell output. V.L.

A82-24169 The influence of surface conditions on the open circuit voltage of silicon solar cells. J. Nijs, F. D'Hoore, R. Mertens, and R. Van Overstraeten (Leuven, Katholieke Universiteit, Louvain, Belgium). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 659-663. 6 refs. Research supported by the Office of the Prime Minister and Nationale Fonds voor Wetenschappelijk Onderzoek.

A series of p(+)nn(+) back-surface-field solar cells have been investigated with reference to the sensitivity of the open-circuit voltage to the surface recombination velocity. It is found that in p(+)nn(+) cells with shallow, relatively low-doped emitters, the emitter is transparent to minority carriers, and the dark saturation current density due to injection of minority carriers is comparable with the bulk component. Thus, the open circuit voltage of these devices is sensitive to the surface condition. V.L.

A82-24170 Electrical properties of grain boundaries in nonsingle crystalline silicon solar cells. W. Schmidt, G. Friedrich, and K.-D. Rasch (Telefunken AG, Heilbronn, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 664-673. 17 refs. Research supported by the Bundesministerium fur Forschung und Technologie.

The paper investigates the effect of grain properties and boundaries on the performance of solar cells made from multicrystalline silicon, including fast-pulled Czochralski-grown silicon and cast silicon. Performance parameters include photovoltaic characteristics, spectral response, effective diffusion length and local photoresponse. Cast silicon with base resistivity higher than 1 omega cm exhibits a uniform photoresponse within the grains comparable to single crystalline silicon cells, and the photoresponse decrease at the grain boundaries is low, due to the predominance of the coherent grain boundaries. It is shown that the local photoresponse can be used as a parameter to characterize grain and grain boundaries. D.L.G.

A82-24171 * Screenable all-metal solar cell electrodes of nickel and copper. B. Ross (Bernd Ross Associates, San Diego, CA) and D. B. Bickler (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 674-678. 6 refs.

Screenable thick film solar cell electrodes are made using the all-metal electrode system, which eliminates the commonly used glass frit and substitutes an oxide scavenger such as silver fluoride. The low temperature firing copper metal systems give good results on solar cells obtaining cell efficiencies of 13% AM1, and adhering sintered structures are demonstrated with nickel systems. The potential effect of copper upon cell performance at elevated temperatures over long periods of time is determined, and it is found that the formation of a copper-silicon eutectic at 550 C produces needle-like structures with broad bases on the silicon, extending into and occasionally through the metallization layer. D.L.G.

A82-24172 Reliable screen-printed contacts on silicon solar cells. J. Michel, H. Baudry (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France), D. Diguet, and G. David (La Radiotechnique Compelec, Caen, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 679-683. 5 refs. Research supported by the Commissariat à l'Energie Solaire.

A screen-printing process for phi 100 mm silicon solar cells is examined. The adherence of silver to silicon is obtained with a glass binder designed to be steam boiling water (SBW) resistant, and the dissolution of the silicon surface by the glass is analyzed. It is found that when the firing temperature of the screen-printed conductors increases, the mechanical and SBW resistance increase; and since the junction depth has to be increased at the same time, the cell output power decreases. A 0.5 micron junction depth and a firing temperature of 680 C appear to be the best trade off, leading to omega 100 mm cells with screen-printed contacts exhibiting good electrical performances, a 300 g standard tensile strength, and over 500 hours SBW lifetime. D.L.G.

A82-24173 * Silicon solar cells with nickel/solder metallization. R. C. Petersen (Solarex Corp., Rockville, MD) and A. Muleo (Solaris S.p.A., Florence, Italy). In: Photovoltaic Solar Energy

Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 684-690. Research supported by the U.S. Department of Energy; Contract No. JPL-954854.

The use of nickel plus solder is shown to be feasible for contact metallization for silicon solar cells by offering a relatively inexpensive method of making electrical contact with the cell surfaces. Nickel is plated on silicon solar cells using an electroless chemical deposition method to give contacts with good adhesion, and in some cases where adhesion is poor initially, sintering under relatively mild conditions will dramatically improve the quality of the bond without harming the p-n junction of the cell. The cells can survive terrestrial environment stresses, which is demonstrated by a 1000 hour test at 85 C and 85% relative humidity under constant forward bias of 0.45 volt. D.L.G.

A82-24174 Status, technology and development of silicon solar cells at INER. S. S. Jao, H. H. Tseng, C. Cheng, Y. C. Tzeng, H. H. Chang, and H. L. Hwang (Institute of Nuclear Energy Research, Lungtan, Republic of China). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 691-695.

Test runs using 200 5-cm-diameter silicon wafers are carried out, yielding 87% with an AM1 conversion efficiency greater than 11.5%. The highest efficiency is 12.7%. Concentrator solar cells of 2 x 2 sq cm are made with an AM1 efficiency of 14%. Solar cells with a diameter of 7.5 cm have attained AM1 efficiencies of more than 11.3%, and texturized solar cells of the same diameter fabricated from rejected wafers show AM1 efficiencies of 9.5-10.5%. It is noted that solar panels comprising 88 cells with a maximum output power of 13.5 W have been manufactured. The results of a 6-month test of a photovoltaic charge station for electric motorcycles are reported. C.R.

A82-24175 * Application of laser annealing to solar cell junction formation. J. S. Katzeff, M. Lopez (Lockheed Missiles and Space Co., Inc., Advanced Manufacturing Technology Dept., Sunnyvale, CA), and R. H. Josephs (California Institute of Technology, Jet Propulsion Laboratory, Energy Conversion Systems Section, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 708-712. Research sponsored by the U.S. Department of Energy and NASA.

The possibility of using high-energy Q-switched Nd:glass lasers to form pn junctions in solar cells by annealing ion-implanted substrates is investigated. The properties of laser annealed cells are analyzed by electrical, transmission electron microscopy, Rutherford backscattering and secondary ion mass spectrometry techniques. Tests indicate the laser annealed substrates to be damage-free and electrically active. Similar reference analysis of ion-implanted furnace-annealed substrates reveals the presence of residual defects in the form of dislocation lines and loops with substantial impurity redistribution evident for some anneal temperature/time regimes. Fabricated laser annealed cells exhibit excellent conversion efficiency. It is noted that additional improvements are anticipated once the anneal parameters for a back surface field are optimized. C.R.

A82-24176 Laser-annealed silicon solar cells - A comparison between ion-beam and glow discharge implantation. J. Michel, C. Fages (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France), J. C. Muller, P. Siffert (CNRS, Centre de Recherches Nucléaires, Strasbourg, France), D. Hoonhout, T. de Jong, and F. W. Saris (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam, Netherlands). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 713-718. 7 refs. Research supported by the Commissariat à l'Energie Solaire.

The goal is to define optimum parameters for the implantation and annealing procedure and to make a comparison between the two ways of implantation. It is noted that shallower implantations lead to better solar cell performance. For low-energy implantations, the laser treatment becomes the dominant factor determining the layer characteristics. In addition, it is found that there is an optimum for the implanted dose and for the laser energy density applied. Relatively large leakage currents are observed, suggesting the presence of defects near the junction probably due to the laser treatment. Furnace annealing is found to be required in every case. C.R.

A82-24178 Comparative study of the thermal characteristics of various solar cell module structures. D. Diguet, J. Anguet (Radiotechnique Compelec, Caen, France), J. Francin, and J. J. Marchal (Société Nationale Industrielle Aérospatiale, Cannes, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 726-730. Commission of the European Communities Grant No. 488-78-3-ESF.

The heat dissipation mechanisms in various solar cell module configurations are analyzed both experimentally and theoretically. A cell in which there is less absorption of infrared sunlight is proposed. Attention is also given to the balance between the conductive and convective effect versus the module design, the room temperature, and the convection system. Temperature data are given for various cell and module designs. It is shown that the best trade-off is obtained from a module in which glass plates are used with specially designed low-infrared-absorbing cells; here, the system 'rejects' the sunlight that is inactive with regard to the electrical conversion efficiency. It is noted that this dissipating structure could be competitive if the cost sharing between cell and encapsulation were modified. C.R.

A82-24179 * Terrestrial photovoltaic performance reference conditions. R. G. Ross, Jr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 731-735. Research supported by the U.S. Department of Energy and NASA.

The rationale behind the selection of key photovoltaic performance reference (reporting) conditions, including the standard Air Mass 1.5 solar spectrum and reference irradiance and cell temperature levels, is investigated. Besides providing a repeatable reference for performance comparisons, it is shown that the choice of reference conditions directly controls the accuracy of array energy output prediction calculations. Conclusions are drawn on the accuracy associated with present reference conditions, and recommendations are made concerning alternative reference conditions with improved accuracy. C.R.

A82-24182 Optical measurement of cell temperature in a solar array. B. Theys, P. Baruch, and J. Maire (Ecole Normale Supérieure, Paris, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 746-750. 7 refs. Commissariat à l'Energie Solaire Contract No. 79-127.

A method is described for measuring the operating temperature of photovoltaic cells in an array. Here, use is made of the temperature shift of those optical parameters of the semiconductor which induce a variation in spectral response. This variation is found to be large for wavelengths near the cut-off wavelength. Also described is a method for measuring the voltages that arise at the panel terminals from illumination of a single cell by two monochromatic beams superposed on the solar illumination. C.R.

A82-24183 * Natural sunlight accelerated weathering of photovoltaic modules. G. A. Zerlaut, T. B. Anderson (DSET Laboratories, Inc., Phoenix, AZ), and J. C. Arnett (California Institute of Technology, Jet Propulsion Laboratory, Energy Technology Section, Pasadena, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 751-755. Research sponsored by the U.S. Department of Energy and NASA.

Photovoltaic modules are exposed to the equivalent of ten years of sunlight aging in an accelerated exposure testing and evaluation program, the objective being to determine the long-term durability characteristics of flat plate modules in comparatively short periods of time. The modules are illuminated with concentrated sunlight in a large, sun-tracking, Fresnel-reflecting solar concentrator. The effects of the accelerated exposure are assessed by performing periodic visual inspections and electrical measurements. It is found that field-experienced failure modes are duplicated, that acceleration factors of 6x to 8x are readily attainable, and that the test method is feasible as a predictive tool for photovoltaic module lifetime durability. C.R.

A82-24185 Surface properties of Cu/2-x/S and its influence on the performance of frontwall Cu/2-x/S-CdS thin film solar cells. F. Pfisterer, B. W. Schock, and J. Wörner (Stuttgart, Universität, Stuttgart, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 762-766. 6 refs.

For obtaining optimal efficiencies and high stability of Cu(2-x)S-CdS solar cells, a post-dipping treatment is found to be necessary. The principal features of this treatment are the production of an elemental copper layer on the surface of the cell and the subsequent oxidation of this layer to form a p(+)-Cu2O-layer that acts as a window layer, thereby preventing surface recombination losses. The formation and proper operation of this surface layer is investigated by various methods, among them measurements of the spectral sensitivity, surface potential stoichiometry of the Cu(2-x)S-layer, electron beam induced current, and Auger-depth profiling. C.R.

A82-24186 An EBIC study of the CdS-Cu2S photovoltaic cell. G. J. Russell, S. Oktik, and J. Woods (Durham, University, Durham, England). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 767-771. 7 refs.

Layers of copper sulfide are grown topotaxially on sulfur faces of single crystals of cadmium sulfide using a plating solution containing cuprous ions. The chosen plane corresponds to the preferred orientation of the surface of grains in the evaporated films used in large area devices. With single crystals, the complexities associated with grain boundaries can be eliminated and it becomes possible to investigate more closely the effects of other crystallographic features on cell performance. This is done using a scanning electron microscope in the electron beam induced current mode. C.R.

A82-24187 Transparent, conductive layers of sprayed indium tin oxide in backwall Cu2S-CdS cells. C. Gril, R. Pommier, J. Marucchi, H. Luquet, M. Perotin, O. Maris, and M. Savelli (Montpellier II, Université, Montpellier, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 772-776.

Results obtained from experiments on the transparency and square resistance of a layer of indium tin oxide are reported. The variations in transparency and square resistance with the thickness of the layer are demonstrated. The influence of this transparency and resistance on cell efficiency is computed, and the thickness required to minimize the losses introduced by the indium tin oxide layer is deduced. C.R.

A82-24189 CdZnS-Cu2S thin film solar cells. S. Martinuzzi, F. Z. Nataren, D. Vassilevski, B. Bouchikhi (Aix-Marseille III, Université, Marseille, France), M. Cadene, M. Moutaki, and M. Rolland (Montpellier II, Université, Montpellier, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 782-786. 7 refs. Commission of the European Communities Grant No. 431-78-1-ESF.

Ternary layers of CdZnS are made through single source evaporation of solid solutions and coevaporation. Photocells are then made with these layers by a solid-state reaction with CuCl. It is noted that the observed photovoltage increases may be explained by an increase in the barrier height. The photocurrent values obtained for CdS-Cu2S cells are conserved up to ZnS concentrations of about 8 percent. C.R.

A82-24190 Cu2S/Zn/x/Cd/1-x/S heterojunction solar cells formed on sprayed Zn/x/Cd/1-x/S films. N. A. Reshamwala, W. B. Hsu, L. C. Burton (Virginia Polytechnic Institute and State University, Blacksburg, VA), and V. P. Singh (Photon Power, Inc., El Paso, TX). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 787-792. 10 refs.

Zn(x)Cd(1-x)S films (x greater than or equal to zero and less than or equal to one) are deposited on glass and tin oxide/glass substrates. The film composition is nominally the same as that of the spray solution. The films are found to have preferred C-axis orientations, with lattice parameter, resistivity and band gap variations similar to those of evaporated ZnCdS films. Wet and dry processed Cu2S/ZnCdS junctions are fabricated. Open circuit voltages of more than 0.6 V are obtained with x greater than about 0.15, the maximum value measured being 0.75 V. C.R.

A82-24191 Heterojunction energy band lineups in Cd/1-x/Zn/x/S/Cu2S solar cells. R. Bennaceur, R. B. Hall, and A. Rothwarf (Delaware, University, Newark, DE). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 793-797. 11 refs. Research supported by the U.S. Department of Energy.

A simple method of calculation is used in determining the energy-band lineups in the Cd(1-x)Zn(x)S/Cu2S junction. Since the Cu2S has a complicated structure, the experimental value of delta E sub c for CdS/Cu2S is used. It is noted that for other compounds, such as Cd(1-x)Zn(x)S/InP, the value of delta E sub c can be calculated; in addition, the effect of the dipole layer for different orientations of the interface can be evaluated. It is also shown that delta E sub c = 0 for x values between 20 and 40% corresponding to the maximum value of the open-circuit voltage with no decrease in the short-circuit current density. Other factors, such as resistivity associated with introducing high concentrations of zinc, can affect solar cell parameters and therefore the overall efficiency. C.R.

A82-24192 Integrated Cu/x/S-CdS thin film solar cell panels with higher output voltages. W. Arndt, G. Bilger, F. Pfisterer, H. W. Schock, J. Woerner, and W. H. Bloss (Stuttgart, Universitat, Stuttgart, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 798-802. 6 refs. Bundesministerium fur Forschung und Technologie Contract No. ET-4045-B; Commission of the European Communities Grant No. ESC-R-003-D.

Large-area production of solar cell modules is made possible by applying integration techniques to thin film Cu(x)S-CdS solar cells. It is noted that integrated modules with output voltages matched to various loads can be realized on a single substrate covered by a single front glass with an integrated front contact. The problem of hermetic sealing can thus be easily solved. It is thought that the thin film modules will be very reliable. Two different types of modules, both having outer dimensions of 29.5 x 14.5 sq cm, are fabricated. The first is made up of 8 cells connected in series with an output current of 0.5 A at 2.8 V; the other comprises 18 cells with an output current of 0.2 A at 6 V, related to AM 1.5 illumination (85 mW/sq cm). C.R.

A82-24194 Hydrogenated a-Si multi-junction solar cells and interference effects in the spectral response. M. Ondris and W. den Boer (Delft, Technische Hogeschool, Delft, Netherlands). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 809-814. 9 refs.

Hydrogenated amorphous silicon multijunction solar cells con-

sisting of stacked p-i-n cells are fabricated. The individual cells are connected in series by means of very thin, highly doped p(+)-n(+) a-Si:H tunnel junctions. The cells are illuminated through a thin semitransparent metal layer acting as a Schottky barrier diode with an upper undoped a-Si:H layer in the case of Au, or as an ohmic contact with a negative barrier in the case of Mg. Highly reflective back contacts are used. It is found that a higher number of stacked cells does not result in higher conversion efficiencies. The open circuit voltage of n stacked cells is nearly equal to n times the open circuit voltage of one cell. Conversion efficiencies of 4% at 80 mW/sq cm sunlight are obtained for single and stacked p-i-n structures. C.R.

A82-24197 Electrical properties of hydrogenated amorphous Si/1-x/Ge/x/ alloys. N. Van Dong, T. H. Danh, and J. Y. Le Ny (Commissariat à l'Energie Atomique, Laboratoire de Physique des Matériaux, Gif-sur-Yvette, Essonne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 830-834. 5 refs.
Research supported by the Commissariat à l'Energie Solaire.

A82-24198 Amorphous Si/1-x/Ge/x/ for high performance solar cell. G. Nakamura, K. Seto, Y. Yukimoto, and K. Shirahata (Mitsubishi Electric Corp., Itami, Japan). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 835-839. 6 refs.

It is noted that the optical gap energy can be controlled in the range between 1.95 eV and 1.14 eV by adding Ge to a-Si:H during the deposition process. As the Ge content in the film increases, however, the photoconductivity and carrier mobilities decrease. A preliminary study is carried out on the cell performance of various structures using an a-SiGe:H film. Spectral response at a wavelength region longer than about 0.6 micron is found to increase in the cells using the a-SiGe:H film. C.R.

A82-24199 Can recombination via interfacial states in MIS solar cells be of advantage. P. T. Landsberg and C. M. H. Klimpke (Southampton, University, Southampton, England). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 846-850. 12 refs.

It is noted that, in an MIS p-type solar cell with donor surface states, loss of photogenerated carriers can occur by band-band recombination via surface states. Depending on the thickness of the insulating layer, however, electrons captured by the surface states may also tunnel into the metal, thereby adding to the light-induced current. A subtle balance therefore exists between the adverse and beneficial effects of the capture of electrons by surface states. This balance is analyzed. C.R.

A82-24201 Efficient solar cells on polycrystalline and highly defected substrates using ion sputtered indium tin oxide. A. P. Genis, C. Osterwald, P. Smith, R. Singh, J. E. Mahan, J. B. DuBow (Colorado State University, Fort Collins, CO), and D. Mills (Hewlett Packard Corp., Loveland, CO). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 856-862. 17 refs.

Indium tin oxide (ITO)/silicon solar cells of practical size (approximately 4 sq cm) and efficiency (more than 11% total area) are fabricated using an optimized ion beam milling/sputter deposition and low pressure oxide growth process. Results for a single crystal silicon substrate and four possibly low-cost polycrystalline substrates are compared. Photovoltaic performance parameters of cells formed on the best polycrystalline material are found to be essentially identical to those of a representative single crystal device. C.R.

A82-24203 Application of amorphous silicon nitride for MIS/inversion layer solar cells. R. Hezel, R. Schörner, and T. Meisel (Erlangen-Nürnberg, Universität, Erlangen, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 866-870. 15 refs.

CVD Si-nitride is shown to exhibit outstanding properties as transparent dielectrics for MIS/inversion layer solar cells. Advantages include a very high density of fixed positive interface charges up to 7 x 10 to the 12th per sq cm, absolute stability up to the nitride deposition temperature of 640 C, low density of fast interface states, and good AR coating with easily adjustable properties. MIS/IL solar cells with AM1 efficiencies of 15% and excellent UV sensitivity are obtained without optimizing the MIS contact and grid structure, and it is concluded that the CVD Si-nitride represents a promising dielectric for the fabrication of MIS/IL solar cells with high efficiency and long term stability for single crystalline and polycrystalline silicon. D.L.G.

A82-24204 Properties of CdSe-MIS solar cells. E. Rickus and D. Bonnet (Battelle-Institut, Frankfurt am Main, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 871-875. Research sponsored by the Bundesministerium für Forschung und Technologie and Commission of the European Communities.

It is noted that, as evidenced from scanning electron microscopy and X-ray goniometer measurements, the short-circuit current denisty of CdSe-MIS cells is strongly influenced by the crystallographic properties of the CdSe layer. Spectral response measurements demonstrate that misorientations lead to a reduced collection efficiency of minority carriers. At the present stage of development, efficiencies near 4% can be realized under AM1 conditions using very simple, not-yet-optimized ZnS antireflection coatings. The extremely thin MIS structure permits cells to be fabricated with low material consumption; efficiencies of 9 to 10% should be possible with further improvements. C.R.

A82-24205 Evaluation of electrodeposited cadmium telluride solar cells. B. M. Basol, O. M. Stafsudd (California, University, Los Angeles, CA), R. L. Rod, and E. S. F. Tseng (Monosolar, Inc., Santa Monica, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980.
Dordrecht, D. Reidel Publishing Co., 1981, p. 878-881. 7 refs.
Contracts No. DE-AC04-79ET-23008; No. XS0-9152-1.

An evaluation is made of Schottky barrier solar cells formed on electrochemically deposited n-CdTe films. The important electrodeposition process variables, that is, tellurium concentration in the electrolyte and the deposition rest potential, are optimized for best solar cell operation. The solar cell parameters for the devices made on as-deposited films are as follows: short-circuit current density, 6 mA/sq cm; open-circuit voltage, 0.57 V; and fill factor, 0.6 (under 100 mW/sq cm illumination). Minority carrier diffusion length in these films is found to be 0.05-0.1 micron. A brief heat treatment in air of the CdTe films greatly improves the solar cell parameters. Cells with efficiencies of the order of 6% are obtained on such films. A larger diffusion length is shown to underlie this improvement. C.R.

A82-24206 Theoretical and experimental study of quantum and energy conversion efficiency in CdTe p-n junctions. D. Lincot, M. Barbe, G. Cohen Solal, and Y. Marfaing (CNRS, Laboratoire de Physique des Solides, Meudon, Hauts-de-Seine, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 882-886. 8 refs.

The quantum efficiency in CdTe p-n junction is calculated taking into account realistic electrical parameters. Experiments are in agreement with computations and show quantum efficiencies as high as 75% without antireflecting coating. The diode dark current is predominantly due to generation recombination in the space charge layer and increases in very shallow junctions. Conversion efficiency is presently limited by surface recombination velocity and low surface doping which leads to surface voltage drops and voltage dependent photocurrent. (Author)

A82-24207 Solar cells based on indium phosphide. N. M. Pearsall, T. J. Coutts, and E. Don (Newcastle-upon-Tyne Polytechnic,

Newcastle-upon-Tyne, England). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 887-891. 8 refs.

The fundamental physics of solar cells based on the nearly ideal solar material indium phosphide (InP) is discussed. The feasibility of sputter deposition of n-type window layers in connection with a program on all sputtered CdS/Cu2S cells is demonstrated. It is pointed out that, in contrast to the InP/CdS combination, there are no obvious reasons for expecting high efficiencies for the ITO/InP device. However, AM1.5 efficiencies of nearly 8% are reported, and it is noted that considerable progress has been made in characterizing the device. C.R.

A82-24208 n ITO spray/p InP solar cells. L. Gouskov, C. Gril, A. Brenac, J. F. Bresse, C. Llinares, E. Monteil, and R. Pommier (Montpellier II, Université, Montpellier, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 892-896. 14 refs. Commissariat à l'Energie Solaire Contract No. 79-132.

Solar cells are prepared by the fabrication method of ITO spray/InP p heterojunctions. Solar power conversion efficiency reaches 10 percent under AM1 conditions on 20 sq mm areas. Two p-type substrates are studied, with heat results obtained using the less doped InP, although the back contacts on the material are not perfectly controlled. The ITO-InP interface is investigated by EBIC profile measurements, and the junction is not localized at the metallurgical interface, but is around 0.8 micron deeper into InP. I-V measurements versus temperature show that two transport processes are competitive, and results agree with the proposed model of buried homojunction. D.L.G.

A82-24210 Characterization of n-CdS/p-Si heterojunction solar cells. L. De Angelis, F. Galluzzi, G. Maletta, E. Scafè, and R. Tomaciello (ASSORENI, Laboratorio di Ricerche di Base, Rome, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 906-910. 5 refs.

Electric and photoelectric characteristics of n-CdS/p-Si devices at various temperatures and illumination levels are reported. Heterojunctions between silicon and transparent semiconductors appear to be promising alternative solar cells, with n-CdS/p-Si junctions showing Voc up to 570 mV and overall efficiencies up to 10 percent. The transport mechanism is described as a multistep thermal assisted tunneling, which is unchanged by illumination, and photoresponses show the expected bandpass behavior with internal quantum yields of about 1. D.L.G.

A82-24211 Performance of ultra high efficiency thin germanium p-n junction solar cells intended for solar thermophotovoltaic application. E. S. Vera, J. J. Loferski, M. Spitzer, and J. Schewchun (Brown University, Providence, RI). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 911-919. 14 refs. NSF-Navy-supported research.

The theoretical upper limit conversion efficiency as a function of cell thickness and junction position is calculated for a germanium p-n junction solar cell. The cell structure is intended for solar thermophotovoltaic energy conversion, incorporating minority carrier mirrors and optical mirrors on both the front and back boundaries of the active part of the device. The role of non-ideal optical and minority carrier mirrors, and the effect of resistivity variations are studied. The theoretical efficiency exceeds 15% for an optimal structure 90 microns thick under 25 W/sq cm illumination from a 1500 C thermal source. This upper limit is higher than the calculated limit of 10% to the conversion efficiency of conventional germanium p-n junctions under the same conditions of illumination. D.L.G.

A82-24212 Thermodynamic limitations of direct solar energy conversion. P. Würfel and W. Ruppel (Karlsruhe, Universität, Karlsruhe, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 922-926. 5 refs.

The paper presents an approach to the thermodynamics of radiation, which allows a straightforward and rigorous determination of the upper limit for the efficiency of converting solar energy into electrical energy. Solar energy is first converted into chemical energy of the electron-hole gas by cooling it to room temperature at a constant number of electron-hole pairs. The chemical energy, which is then converted into electrical energy, is not restricted by thermodynamics. The irreversibility of the cooling process limits the AM0 for a single solar cell to a maximum of 0.29 for a bandgap of 1.3 eV, although it can be reduced considerably in more complex systems. D.L.G.

A82-24213 Thermodynamic limits to photovoltaic solar energy conversion efficiency. P. Baruch, C. Picard (Ecole Normale Supérieure, Paris, France), and R. M. Swanson (Stanford University, Stanford, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 927-932. 11 refs. Research supported by the Centre National de la Recherche Scientifique.

A derivation of the Carnot factor is discussed, using a two-level system as a model of a quantum converter. It is shown that in a 4-pi configuration, the thermodynamic limit can be reached in the case of purely radiative recombination. It is also demonstrated that in the usual configuration of a solar cell, a Carnot efficiency can still be used if the hot reservoir temperature is defined as the temperature the electronic population would reach if it were thermally uncoupled from the lattice. The use of simple thermodynamic quantities leads to simple computation of maximum theoretical efficiencies for photovoltaic conversion, and the introduction of source effective temperatures is convenient and allows the isolation of the irreversible processes limiting the efficiency. D.L.G.

A82-24219 Low resistance solar cells for the first Spanish concentrating photovoltaic array. G. L. Araujo, G. Sala, F. Chenlo, E. Sánchez, A. Luque, E. Lorenzo, and J. M. Ruiz (Escuela Técnica Superior de Ingenieros de Telecomunicación, Madrid, Spain). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 960-964. 6 refs.

A two-axis photovoltaic tracking array of 20.8 sq m aperture has been developed, which is equipped with monocrystalline silicon solar cells and hybrid silicone-glass Fresnel lenses, and is capable of yielding 1.5 KW peak under AM1 conditions. It is shown that the use of certain two-level metallization grids reduces the series resistance and improves the performance of concentration of solar cells. The series resistance values of n(plus)p silicon solar cells with a 5 cm diameter and an efficiency of 16.6 percent at AM1 are measured. The 6 C thermal drop between the cell and the cooling element for AM1 irradiance are also measured. D.L.G.

A82-24221 High efficiency large area AlGaAs/GaAs concentrator solar cells. S. Yoshida, K. Mitsui, T. Oda, Y. Yukimoto, and Y. Shirahata (Mitsubishi Electric Corp., LSI Research and Development Laboratory, Itami, Hyogo, Japan). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 970-974. 6 refs.

The design, construction, and performance of a 1 kW AlGaAs/GaAs solar cell array is described, along with problems associated with realization of the array. The array features two panels, each with 90 27 × 27 cm Fresnel lenses above 4 sq cm solar cells. The panels are mounted on a two axes tracking system, and cooling is supplied by an aluminum plate for natural convection. The lenses provide 125 suns concentration for the series-connected cells. The photovoltaics were grown by a liquid phase epitaxial growth technique which produced a 24 sq cm wafer, and a p-n homojunction was formed by diffusing Zn during the p-AlGaAs epitaxial growth. A maximum output of 9.1 W was achieved at 125 suns, and the cells

were soldered to a ceramic base to furnish electrical isolation between the cells and the heat sink. An array power of 977 W was obtained at an efficiency of 14.2%, with losses due to tracking errors and lens-cell misalignment. M.S.K.

A82-24222 Optical characteristics of the dispersion concentrator and its influence on photovoltaic systems. G. Sassi (Milano, Università, Milan, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 981-985.

The realization of an optical dispersion concentrator for splitting solar radiation into the different wavelength components for deposition on solar cells sensitive to the deposited wavelengths is discussed. Problems due to scattering by the splitting and focussing lens are examined, including the distribution of wavelengths at the focal point. The solar cells are then arranged so that the light which strikes them exceed the individual energy gaps. Highest energy densities were found at the periphery of the focal zone, with UV rays striking the center, and the possibility of altering the shape of the focal zone to accord with individual requirements is mentioned. The cells can also be distributed in the focal zone so that series connections of cells responding to the identified wavelengths will produce equal outputs. Linear configurations with same apparatus are noted to necessicate lower concentration ratios for higher utilization, and therefore higher cost. M.S.K.

A82-24223 Automated concentrator cell module assembly. S. Olah and W. Sampson (Applied Solar Energy Corp., City of Industry, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 991-995.

The performance and features of linear concentrator photovoltaic arrays fabricated partially by an automated soldering machine are detailed. Float zone Si cells were mounted in five linear modules each 1.2 m long containing 48 cells. The cell strings were made up of 4 12-cell segments encapsulated in polyvinyl butyral, with two bypass diodes for every segment. An efficiency of 16.4% was achieved at 55 C, and humidity tests showed no performance degradation or cracks in an Al303 coating. The automatic soldering machine comprised a ribbon feeding system, an interconnect punch die, a solar cell feeder and soldering mechanism, a ribbon separation mechanism with cut-off die and outfeed, and a program control. The machine operated with low-line voltage, compressed air, and vacuum, and the processing of the cells is outlined, including cell soldering by a point contact method with a controlled immersion heater. Standardization of cell sizes is recommended to ensure flexibility of cells which can be handled. M.S.K.

A82-24224 Construction and testing of experimental plants using solar cells and concentrators. H. Pfeiffer (Maschinenfabrik Augsburg-Nürnberg AG, Munich, West Germany). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 996-1000. 6 refs. Research supported by the Commission of the European Communities and Bundesministerium für Forschung und Technologie.

A82-24225 Multibandgap cells in a thermophotovoltaic system. F. Demichelis and E. Minetti-Mezzetti (Torino, Politecnico, Turin, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1006-1011. 9 refs. Research supported by Fiat S.p.A.

Designs for a thermophotovoltaic (TPV) converter which employs a Fresnel concentrating lens and a parabolic reflector as a collector are described. Solar radiation is concentrated onto two hollow hemispheres near the focus of two parabolic mirrors where low reradiated levels of the incoming flux are redirected by filters onto different cells. Symmetric coupled differential equations are developed to describe the time-dependence of the TPV converter, which uses multibandgap cells to achieve efficiencies of up to 45%. M.S.K.

A82-24226 Description of a concentrating photovoltaic energy system for Wilcox Memorial Hospital on Kauai. D. Rafinejad (Acurex Corp., Alternate Energy Div., Mountain View, CA). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1012-1015. Research sponsored by the U.S. Department of Energy.

A82-24227 Community television reception centers with solar generator power supplies in Niger - Television retransmitters with alternative energy power supplies in France (Centres de réception communautaire de télévision alimentés par générateurs solaires au Niger - Réémetteurs de télévision alimentés par les énergies nouvelles en France). S. Polgar (TéléDiffusion de France, Montrouge, Hauts-de-Seine, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1018-1022. In French.

A82-24228 Solar cell/battery plants for telecommunication systems in Denmark - Development of a test facility. J. Jensen (Odense, Universitet, Odense, Denmark). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1023-1027. Research supported by the Department of Energy of Denmark; European Economic Community Contract No. 315-78-EEDK.

A82-24229 The 5 kW generator at the Alpine refuge 'Les Evettes' - Operating data. L. Selles (SERI-Ranault Ingénierie, Bois-d'Arcy, Yvelines, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1028-1032. Commission of the European Communities Grant No. 463-78-1-ES-F.

[illegible] components and performance of a remotely sited prototype solar cell power supply for a hotel with no grid connection are detailed. The array provides a peak output of 5 kW at 48-70 V dc and batteries comprising 120 lead-acid elements hold five days of power for nominal use. Power conditioning is accomplished by a 3 kVA inverter equipped with thyristors which perform at 80 percent with a full load and 67 percent at part load. Data recording consisted of 12 channels for irradiance, temperature, current, voltage, power, etc. The cells delivered an average of 28.2 kWh/day minimum in Aug. 1980. The use of voltage matching devices is recommended to increase solar cell efficiency, along with higher battery voltages in the inverter to cope with more widely varying loads. M.S.K.

A82-24230 Optimization of the P.V. array-load energy transfer by means of an electronic adaptator. J. Pivot, J. A. Roger (Lyon I, Université, Villeubanne, Rhône, France), P. Gucher, B. Canut, and E. Descours (Lyon, Facultés Catholiques, Lyon, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1033-1037. Commissariat à l'Energie Solaire Contracts No. 78-03192; No. 78-03292.

Operational characteristics and circuitry of adaptors for direct coupling of photovoltaics to loads are discussed. Direct coupling to load is noted to be the cheapest available method for utilization of solar cell-produced power, and necessitates dc-dc conversion to allow performance of cell modules at optimum levels in matching the load. Adaptors are necessarily powered by the power source, have high reliability in all climates, and respond to photovoltaic curve temperature shifts. A series adaptor is transistorized, with two capacitors charged and discharged in sequence in reference to a load capacitor designed for the required levels, and responding to light flux and cell temperature. A parallel adaptor has a blocking circuit of thyristors and a light flux follower to pilot a driving circuit to fix the working points at maximum power points of the array regardless of temperature and light flux. The series chopper is noted to be effective for powers lower than 1.5 kW. M.S.K.

A82-24231 Interconnection of a photovoltaic power generation system with the grid. R. Corbefin and G. Vacelet (Société Nationale Industrielle Aérospatiale, Paris, France). In: Photovoltaic

Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1038-1040. In French.

Converting photovoltaic system-generated power into a form compatible with grid-furnished power and simultaneously ensuring that maximal power is drawn from the solar system is discussed. A converter is interposed between the solar-derived electricity and the grid lines, allowing the user to apply the power to a load, feed excess power to the grid, and receive power from the grid when the photovoltaic output is too low to fill demand. A dc-ac converter is described, with microprocessor controlled transistorized switching to adapt the solar output to the load amplitude on demand, while maintaining constant voltage. An adaptor allows the converter to take its amplitude, phase, and frequency regulation from the grid, and also assures that power will flow only toward the grid. M.S.K.

A82-24232 Power conditioning unit for photovoltaic power systems. G. Beghin and V. T. Nguyen Phuoc (Précision Mécanique Labinal, S.A., Vanddeuvre, Seine-Saint-Denis, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1041-1045.

Operational features and components of a power conditioning unit for interconnecting solar cell module powers with a utility grid are outlined. The two-stage unit first modifies the voltage to desired levels on an internal dc link, then inverts the current in 2 power transformers connected to a vector summation control to neutralize harmonic distortion up to the 11th harmonic. The system operates in parallel with the grid with extra inductors to absorb line-to-line voltage and phase differences, and permits peak power use from the PV array. Reactive power is gained internally, and a power system controller monitors voltages, frequencies, and currents. A booster preregulator adjusts the input voltage from the array to provide voltage regulation for the inverter, and can commutate 450 amps. A total harmonic distortion of less than 5 percent is claimed, with a rating of 5 kVA, 50/60 Hz, 3-phase, and 4-wire. M.S.K.

A82-24233 New type of transformerless high efficiency inverter. G. J. Naaijer (Laboratoires d'Electronique et de Physique Appliqueé, Limeil-Brévannes, Val-de-Marne, France). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p.1068-1072. Research supported by the Commissariat à l'Energie Solaire.

Inverter architectures are presented which allow economical ac/dc switching for solar cell array and battery power use in domestic and industrial applications. The efficiencies of currently available inverters are examined and compared with a new 2.2 kW transformerless stepped wave inverter. The inverter has low no-load losses, amounting to 200 Wh/24 hr, and features voltage steps occurring 15-30 times/sine wave period. An example is provided for an array/battery/inverter assembly with the inverter control electronics activating or disconnecting the battery subassemblies based on the total number of activated subassemblies in relation to a reference sinewave, and the need to average the battery subassembly discharge rates. A total harmonic distortion of 6 percent was observed, and the system is noted to be usable as a battery charger. M.S.K.

A82-24234 Considerations on the feasibility of A 1 MWp central PV plant to be tied to the European electrical network. P. Bullo, S. Corsi, V. Piazza (Ente Nazionale per l'Energia Elettrica, Direzione Studi e Ricerche, Milan, Italy), G. Emanuele (Phoebus, Catania, Italy), G. Gelli (Officine Galileo S.p.A., Florence, Italy), and M. Giuffrida (Ansaldo Elsag /AE/, Genoa, Italy). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1076-1081. 6 refs.

A functional analysis of an optimized centralized photovoltaic power plant is presented. The incorporation of meteorological data, the anticipation of uneven cell performance, the avoidance of shadowing, and isolation of defective panels by using by-pass diodes are considered. An optical module consisting of a parabolic trough with an aperture of 1.7 m with a focal distance of 750 mm was chosen, with provision made for tracking. The power conditioning unit comprised a dc/ac thyristor converter with natural commutation. Lightning protection is outlined, along with an optimal plant layout. Finally, cost considerations for land and the solar cell modules are discussed, including cost levels required to make the operation of a photovoltaic plant economical. M.S.K.

A82-24235 Thin-film polycrystalline /CdZn/S/Cu2S solar cells of 10% conversion efficiency. R. B. Hall, R. W. Birkmire, J. E. Phillips, and J. D. Meakin (Delaware, University, Newark, DE). In: Photovoltaic Solar Energy Conference; Proceedings of the Third International Conference, Cannes, France, October 27-31, 1980. Dordrecht, D. Reidel Publishing Co., 1981, p. 1094-1096. 5 refs. Research supported by the U.S. Department of Energy.

An important limitation on the efficiency of CdS/Cu2S solar cells is the open circuit voltage attainable with the CdS/Cu2S heterojunction. The electron affinity mismatch between CdS and Cu2S of approximately 0.2 eV limits the achievable open circuit voltage to about 0.5 V. A modified heterojunction using a mixed Cd-Zn sulfide that has been proposed as a means of achieving an open circuit voltage of about 0.7 V is tested. C.R.

A82-24293 The effects of elevated temperature exposure on the compatibility of glycol solutions with metals used in solar absorbers. E. F. Smith, III and E. Davis (Olin Metals Research Laboratories, New Haven, CT). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper.* 18 p. 6 refs. Research supported by the International Copper Research Association.

A laboratory study was conducted to evaluate the corrosion compatibility of various metals with water-glycol mixtures at temperatures reached in a stagnating solar collector. This initial scoping study examined the corrosion response of aluminum, copper, low carbon steel and a stainless steel alloy after elevated temperature exposure to a 50 v/o solution of reagent grade glycol in water. The test procedure included exposure to both liquid and vapor phases for periods of up to thirty days. These initial tests were performed to establish baseline performance data for both propylene and ethylene glycol solutions. In future studies, this baseline will be used to evaluate the effectiveness of various commercial additive packages to the water-glycol mixtures. (Author)

A82-24294 The effect of degradation of glycols on corrosion of metals used in non-concentrating solar collectors. J. A. Beavers and R. B. Diegle (Battelle Columbus Laboratories, Columbus, OH). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper.* 24 p. 8 refs. Contract No. DE-AC04-79CS-10510.

Chemical degradation of aqueous ethylene glycol and propylene glycol solutions has been investigated at 100 and 180 C in solutions containing metals currently considered for use in nonconcentrating solar collectors, namely, copper, steel, and aluminum. It is shown that degradation of ethylene glycol and propylene glycol during simulated solar collector operating conditions is catalyzed by the presence of metals, resulting in the formation of acidic byproducts and a reduction of pH. This, in turn, accelerates corrosion of the metals studied. It is concluded that corrosion inhibitors and buffering agents are necessary in order to attain a reasonable design life of 10 to 20 years for nonconcentrating solar collector systems. V.L.

A82-24298 * Development of an accelerated reliability test schedule for terrestrial solar cells. J. W. Lathrop and J. L. Prince (Clemson University, Clemson, SC). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper.* 20 p. Research sponsored by the U.S. Department of Energy and NASA.

An accelerated test schedule using a minimum amount of tests and a minimum number of cells has been developed on the basis of stress test results obtained from more than 1500 cells of seven different cell types. The proposed tests, which include bias-temperature, bias-temperature-humidity, power cycle, thermal cycle, and thermal shock tests, use as little as 10 and up to 25 cells, depending on the test type. V.L.

A82-24299 * Atmospheric corrosion model and monitor for low cost solar arrays. D. H. Kastle, F. B. Mansfeld, S. L. Jeanjaquet, and M. Kendig (Rockwell International Science Center, Thousand Oaks, CA). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper.* 13 p. 5 refs. Research sponsored by the U.S. Department of Energy; Contract No. JPL-954739.

An atmospheric corrosion model and corrosion monitoring system has been developed for low cost solar arrays (LSA). The corrosion model predicts that corrosion rate is the product of the surface condensation probability of water vapor and the diffusion controlled corrosion current. This corrosion model is verified by simultaneous monitoring of weather conditions and corrosion rates at the solar array test site at Mead, Nebraska. (Author)

A82-24589 * Forced convection heat transfer for two-phase helical flow in a solar receiver. J. R. Dunn and F. N. Vafaie (Texas Tech University, Lubbock, TX). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/HT-13.* 9 p. 9 refs. Members, $2.00; nonmembers, $4.00. Research supported by the U.S. Department of Energy.

The heat transfer characteristics of a single-tube, helically coiled receiver for a concentrating solar collector are presented. Heat transfer coefficients were measured for single- and two-phase water-stream flow in a helical coil subjected to radiant heating for a range of flow conditions and radiant flux levels. Results are presented for both the local and average heat transfer coefficients in several flow regimes and the results correlated with non-dimensional, geometric, fluid, and flow parameters. (Author)

A82-24605 # Method of testing solar collectors for determination of heat transfer parameters. A. R. Shouman and I. A. Tag (New Mexico State University, Las Cruces, NM). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-2.* 5 p. 6 refs. Members, $2.00; nonmembers, $4.00. Research supported by the University of Petroleum and Minerals.

An experimental program is developed for including the temperature measurements of the absorber plate at the fluid inlet and outlet locations for inclusion in theoretical analyses of the heat transfer parameters of a flat plate solar collector. The steady-state one-dimensional equation for the fluid temperature, the actual plate temperature for a uniform flow collector, and a characteristic temperature for a uniform flow in the collector tubes are considered. The Hottel-Whillier, and Bliss solution (1958, 1959) is shown to neglect axial conduction in the fluid and the receiver, and a method is found for correct calculation for the effective transmittance-absorptance product, which is crucial for determining the efficiency of the collector. End losses are also observed to be significant, and it is recommended that measurements of inlet and outlet temperatures be performed in order to separate the heat transfer parameters. M.S.K.

A82-24606 # On reducing convective losses from cover glazings of solar thermal collectors. P. Raghuraman and D. Kon (MIT, Lexington, MA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-3.* 8 p. 21 refs. Members, $2.00; nonmembers, $4.00. Research supported by the U.S. Department of Energy.

Convective heat losses from cover glazings of solar thermal collectors are reduced by forming perpendicular crisscross rectangular grooves on the glazing which cause the air flow to form recirculating zones in the grooves. Experiments on the effects of varying groove geometry show that the cover glazing convective heat transfer coefficient can be reduced by a factor of four or better. Results of the experimental and analytical work and a description of the design considerations in optimizing the groove geometry are presented. (Author)

A82-24607 # Heat transfer characteristics of a back-corrugated absorber surface for solar air collectors. K. A. Shockey, J. T. Pearson, and D. P. DeWitt (Purdue University, West Lafayette, IN). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-5.* 6 p. 8 refs. Members, $2.00; nonmembers, $4.00. Contract No. EM-78-C-04-5366.

The present study experimentally examines a back-corrugated absorber-convector comprised of a rectangularly corrugated plate attached to the back side of a flat absorber plate with a high temperature, high strength adhesive. The upper surface is subjected to a heat flux from a blanket-type electric heater simulating solar irradiation. The corrugated plate configuration creates two parallel airflow channel types. The two channels have different geometries and, therefore, may have different heat transfer characteristics. An apparatus was designed to determine the local convective heat transfer coefficients along each of the channels. The results show that the back-corrugated absorber-convector has much better thermal performance than the simple flat-plate absorber-convector, mainly because of the increased connective heat transfer area. (Author)

A82-24608 # On the weathering of thin plastic films. H. Cheng and R. B. Bannerot (Houston, University, Houston, TX). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-6.* 9 p. 11 refs. Members, $2.00; nonmembers, $4.00.

Results and procedures of an ongoing testing program to determine the weatherability of thin film plastic covers for use in flat plate solar collectors are reported. The program was designed to isolate the effects of the environment, insolation, i.e. UV radiation, thermal radiation, and mechanical forces. Actual outdoor operating conditions were used to avoid inaccuracies previously obtained using accelerated conditions or thick plastic sheets. Solar transmittance of collector candidate materials was determined from radiance monitoring, angle of incidence, spectral measurements, and consideration was given to synergistic effects of various weathering mechanisms. The design and fabrication of outdoor testing apparatus are described, with examples of trials of a 0.025 mm sheet of fluorinated copolymer FEP and a 0.1 mm thick sheet of polyvinyl fluoride. Samples were cut every month and analyzed. Thermal effects were found to contribute 80% of the transmittance degradation, with summer degradation showing the highest rates. UV radiation was found to have little effect on degradation rates. M.S.K.

A82-24609 # Actual versus predicted performance of an active solar heating system - A comparison using FCHART 4.0. P. E. Wetzel (Automation Industries, Inc., Silver Spring, MD). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-7.* 9 p. Members; $2.00; nonmembers, $4.00. Contract No. DE-AC01-79CS-30027.

The performance of an active solar heating system added to a house in Denver, CO was compared with predictions made by the FCHART 4.0 computer program. The house featured 43.23 sq m of collectors with an ethylene-glycol/water heat transfer fluid, and a 3.23 cu m storage tank. The house hot water was preheated in the storage tank, and home space heat was furnished whenever the storage water was above 32 C. Actual meteorological and heating demand data were used for the comparison, rather than long-term averages. Although monthly predictions by the FCHART program were found to diverge from measured data, the annual demand and supply predictions provided a good fit, i.e. within 9%, and were within 1% of the measured solar energy contributed to storage. M.S.K.

A82-24610 # Passive cooling measurements for a concentrating photovoltaic array. F. K. Deaver (Arkansas, University, Fayetteville, AR) and M. W. Edenburn (Sandia National Laboratory, Albuquerque, NM). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-10.* 5 p. Members, $2.00; nonmembers, $4.00. Research supported by the U.S. Department of Energy.

Solar cells in a concentrating photovoltaic array absorb heat that must be removed. One method is to use a finned aluminum heat exchanger whose modeling requires estimating the coefficient of heat transfer from fins to surroundings; transfer depends on such parameters as wind speed and direction, and exchanger design. A transient analytical model has been constructed and applied to experimental data. Coefficients of heat transfer were calculated and correlated with wind speed and direction, which appear to have a definite effect on the overall coefficient. The transient model and

apparent relationships between wind speed and convective coefficients are described. (Author)

A82-24611 # Systematic rotation and receiver location error effects on parabolic trough annual performance. G. W. Treadwell and N. R. Grandjean (Sandia National Laboratory, Albuquerque, NM). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-12.* 5 p. 7 refs. Members, $2.00; nonmembers, $4.00.

The effects of systematic geometrical design errors and random optical errors on the accuracy and subsequent economic viability of solar parabolic trough concentrating collectors were studied to enable designers to choose and specify necessary design and material constraints. A three-dimensional numerical model of a parabolic trough was analyzed with the inclusion of errors of pointing and mechanical deformation, and data from a typical meteorological year. System errors determined as percentage standard deviations provided the range of a study for systematic rotation and receiver location errors. The two types of errors were found to produce compounded effects. It is concluded that the designer must choose performance levels which take into account existence of errors, must know to what level the errors can be eliminated and at what cost, and should make provisions for monitoring the day-to-day on-line focus of the troughs. M.S.K.

A82-24612 # Design, fabrication, and evaluation of an innovative woven-screen solar collector. J. A. Bryant, R. R. Clark (New Mexico State University, Las Cruces, NM), and I. A. Tag (Oak Ridge National Laboratory, Oak Ridge, TN). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-13.* 3 p. 6 refs. Members, $2.00; nonmembers, $4.00.

A low-cost woven screen solar air collector is described, and performance and costs are compared with conventional flat-plate collectors. A wire screen mesh is mounted in the center of a collector, between the glazing and the insulated back surface, and PVC pipe inlets allow air flow into the collector from above the mesh. A central outlet duct receives the heated air beneath the mesh. A 16.3 sq ft collector features an efficiency of nearly 50%, with a pressure drop of 0.5 in. at a mass flow rate of 279.4 lbm/hr. A lifetime of 5-7 yr is expected with a unit which costs $150, with a per foot cost of $9.10/sq ft as compared with currently marketed solar air collectors at $15.90/sq ft. The lower pressure drop is noted to allow lower power requirements for a circulating fan. M.S.K.

A82-24613 # The effect of nonuniform fluid flow distribution on the thermal performance of solar collector. J. P. Chiou (Detroit, University, Detroit, MI). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-14.* 9 p. 20 refs. Members, $2.00; nonmembers, $4.00.

The effect of flow nonuniformities due to pipe clogging, misplaced pipe headers, and poor design of solar flat plate collectors is considered analytically for 16 different flow maldistributions. The inlet and outlet tubes are assumed to be connected to headers on the flat plates, resulting in a parallel flow in the fluid circuit. Governing equations are defined for the absorber plate and heat transfer fluid, along with suitable boundary conditions, and numerical solutions are obtained. Collector efficiency is determined for uniform and nonuniform flow condition to set a collector efficiency deterioration factor. The effect of longitudinal heat conduction was found to be negligible, and flow nonuniformities were observed to always cause performance deterioration in flat plate collectors, ranging from 2-20% of the thermal efficiency, and depending on the pattern of flow disturbance. M.S.K.

A82-24614 # Thermal analysis of a solar pond power plant operated with a direct contact boiler. A. Sonn and R. Letan (Negev, University, Beersheba, Israel). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-15.* 10 p. 11 refs. Members, $2.00; nonmembers, $4.00. Research supported by the Ministry of Energy of Israel.

A solar pond power plant operated with a direct contact boiler was thermally analyzed. A binary cycle system of concentrated brine, and an organic working fluid were considered. Brine temperature of 80 C, condensation at 30 C, a 75 percent efficient turbine, and 70 percent efficient pumps were specified for the analysis. The current study involved six working fluids: butane, pentane, hexane, and freons R113, R114, R12. Each of these fluids exhibited a maximum efficiency of the system at characteristic operating conditions of the boiler. The system efficiency increased as the boiler pressure approached that of the pond. Net electrical outputs of 7-9 percent of the heat inputs were obtained for the low pressure fluids, such as pentane, hexane, and R113. Gravity flow of brine to boiler increased these values to 8-11 percent. Solute losses in brine by direct contact in boiler were estimated for pentane, as 125 kg per year per sq km of pond, or 63 kg/MWe-year. Similar orders of magnitude are obtained for the other fluids. (Author)

A82-24615 # Effects of friction and extraction on the stability of solar ponds. Y. S. Cha, W. T. Sha (Argonne National Laboratory, Argonne, IL), and S. L. Soo (Illinois, University, Urbana, IL). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-16.* 10 p. 23 refs. Members, $2.00; nonmembers, $4.00. Contract No. W-31-109-eng-38.

Theoretical stability analyses are compared with experimental and theoretical results on the effects of internal barriers and stratification on solar pond performance. Stability criteria are defined, and the use of walls in the gradient zone are demonstrated to permit lower salt concentrations with no loss in performance, although stable operating ranges were close to unstable levels. Additionally, the use of perforated walls is shown to increase internal friction, assuring a stable nonconvective gradient layer. The feasibility of withdrawal of heated liquid from the bottom layer is proven to not damage the longitudinal stability as long as the rate of withdrawal is within the ranges of laminar motion. An example is provided for the case of withdrawal in the absence of solar input, and it is concluded that the introduction of perforated boundaries may permit the operation of solar ponds without salt gradients. M.S.K.

A82-24616 # The potential economic benefit of using parabolic trough collectors to supplement power cycle boilers. W. P. Schimmel, Jr. and L. L. Lukens (Sandia National Laboratory, Albuquerque, NM). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-17.* 7 p. 9 refs. Members, $2.00; nonmembers, $4.00. Research supported by the U.S. Department of Energy.

An economic analysis is presented for a combined parabolic trough solar/fossil fuel hybrid power plant. Applications are considered for investor-owned utilities and industries with stockholders and bond purchasers. Annual levelized revenues are calculated, based on the capital cost of equipment, annual operations and maintenance, and a rising cost of fossil fuel. The units of heat are considered as equal in value from each source, and project return on equity for an American Southwest user of the hybrid systems are calculated to show an annual project return on equity of 21% for a utility and 25% for an industry in 1985. Analysis of the total fuel replaced by a solar reheat system for a gas-fueled boiler system shows that a 20% reduction in fuel costs can be obtained by a 10% increase in the plant costs to include the solar reheat system furnishing low-temperature heat in 1985. M.S.K.

A82-24617 # Comparison of test results for flat plate, transpired flat plate, corrugated, and transpired corrugated solar air heaters. S. J. Rhee and D. K. Edwards (California, University, Los Angeles, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-18.* 8 p. 26 refs. Members, $2.00; nonmembers, $4.00. Contract No. DE-FG04-77CS-34088.

Results from tests to demonstrate technical improvements from transpiring and/or corrugating a selective black absorber plate solar air collector are reported. A literature review is presented, and the specific working components of transpired and nontranspired flat and corrugated absorbers are provided, including transpiration through slots, a microperforated plate, a corrugated plate, and a transpired, slotted, corrugated plate. Inlet and outlet temperatures were monitored, and inlet air was controlled, with trials covering temperatures of 38, 60, 82, and 104 C to test the effect of maintaining the fluid temperature close to the collector temperature. No differences were observed in running the collectors with corrugations vertically instead of horizontally, and the collector with

transpiration through slots was found to display the lowest pressure drop. M.S.K.

A82-24620 * // Rankine engine solar power generation. I - Performance and economic analysis. A. A. Gossler and J. E. Orrock (Honeywell Technology Strategy Center, Roseville, MN). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-22.* 5 p. 6 refs. Members, $2.00; nonmembers, $4.00. NASA-supported research.

Results of a computer simulation of the performance of a solar flat plate collector powered electrical generation system are presented. The simulation was configured to include locations in New Mexico, North Dakota, Tennessee, and Massachusetts, and considered a water-based heat-transfer fluid collector system with storage. The collectors also powered a Rankine-cycle boiler filled with a low temperature working fluid. The generator was considered to be run only when excess solar heat and full storage would otherwise require heat purging through the collectors. All power was directed into the utility grid. The solar powered generator unit addition was found to be dependent on site location and collector area, and reduced the effective solar cost with collector areas greater than 400-670 sq m. The sites were economically ranked, best to worst: New Mexico, North Dakota, Massachusetts, and Tennessee. M.S.K.

A82-24621 // Rankine engine solar power generation. II - The power generation module. W. D. Batton and R. E. Barber (Barber Nichols Engineering Co., Arvada, CO). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-23.* 6 p. 7 refs. Members, $2.00; nonmembers, $4.00.

The characteristics and performance of a solar flat plate collector powered low temperature power generation module (PGM) funded by NASA are described. The PGM uses a halogen refrigerant as a working fluid, which is pumped from a reservoir to a chamber where it is heated by exchangers filled with an ethylene-glycol fluid which has gained thermal energy from a collector array. The heated refrigerant is allowed to expand through turbine blades and exits through a regenerative heater to condensation into the original well. The PGM was built mainly from off-the-shelf components, except for the turbo-gearbox, which was fabricated specifically for the PGM and attains the design goal of 80% efficiency, producing 13.8 kW at the design point. The components and controls are detailed, including start-up and shutdown, and safety procedures. The testing program is outlined, and 6000 hours of operating experience has resulted in a 7.2% efficiency. M.S.K.

A82-24622 * // Ceramic technology for solar thermal receivers. A. A. Kudirka and R. H. Smoak (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-24.* 9 p. 10 refs. Members, $2.00; nonmembers, $4.00. Research sponsored by the U.S. Department of Energy and NASA.

The high-temperature capability, resistance to corrosive environments and non-strategic nature of ceramics have prompted applications in the solar thermal field whose advantages over metallic devices of comparable performance may begin to be assessed. It is shown by a survey of point-focusing receiver designs employing a variety of ceramic compositions and fabrication methods that the state-of-the-art in structural ceramics is not sufficiently advanced to fully realize the promised benefits of higher temperature capabilities at lower cost than metallic alternatives. The ceramics considered include alumina, berylia, magnesia, stabilized zirconia, fused silica, silicon nitride, silicon carbide, mullite and cordierite, processed by such methods as isostatic pressing, dry pressing, slip casting, extrusion, calendaring and injection molding. O.C.

A82-24623 // Assessment of generic solar thermal systems for large power applications. W. J. Apley and S. P. Bird (Battelle Pacific Northwest Laboratories, Richland, WA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-25.* 9 p. 12 refs. Members, $2.00; nonmembers, $4.00. Research sponsored by the U.S. Department of Energy.

An assessment and ranking of solar thermal power systems capable of producing over 10 MWe is presented as a basis for decisions by the DOE on which systems to continue funding. The systems were organized generically into two-axis tracking, one-axis tracking, and nontracking systems. Configurations were ranked on the basis of lowest energy cost. Some form of concentration was found to be necessary for stationary collectors to achieve acceptable conversion efficiencies. Plant sizes of 50, 100, and 200 MWe, were analyzed with the energy output coupled to a plant capacity factor. Estimates included requirements of grid interconnection, strictly electric output, and using Barstow, CA climatological data summaries. The point focus central receiver with Rankine cycle displayed the highest ranking for electricity costs coupled with plant capacity factor, while the point focus distributed receiver with either Rankine or Brayton cycles were highest with no storage. M.S.K.

A82-24624 * // Comparison of electrochemical and thermal storage for hybrid parabolic dish solar power plants. H. L. Steele and L. Wen (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-27.* 8 p. 12 refs. Members, $2.00; nonmembers, $4.00. Research sponsored by the U.S. Department of Energy and NASA.

The economic and operating performance of a parabolic point focus array of solar electricity generators combined with either battery or thermal energy storage are examined. Noting that low-cost, mass-producible power generating units are under development for the point focus of distributed dishes, that Zn-Cl battery tests will begin in 1981 and a 100 kWh Na-S battery in 1983, the state of thermal storage requires acceleration to reach the prototype status of the batteries. Under the assumptions of 10,000 units/yr with an expected 30 yr lifetime, cost comparisons are developed for 10 types of advanced batteries. A 5 MWe plant with full thermal or 80% battery storage discharge when demand occurs in conditions of no insolation is considered, specifically for Fe-Cr redox batteries. A necessity for the doubling of fuel prices from 1980 levels by 1990 is found in order to make the systems with batteries economically competitive. M.S.K.

A82-24625 // Optimization of a hybrid solar thermal power system. R. E. Irwin, D. A. Rodriguez, and R. L. Pons (Ford Aerospace and Communications Corp., Aeronutronic Div., Newport Beach, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-28.* 6 p. 6 refs. Members, $2.00; nonmembers, $4.00.

An optimized collector area/storage medium is modelled for applications of a 1 MWe solar electric plant for a prototype Community Solar Experiment power module. The battery storage system considered is the lead-acid and sodium-sulfur batteries, and an annualized capacity factor of unity is set as the goal for the combined system, including supplemental fuel burning. A total of 90 parabolic point focus dish concentrators were calculated to be necessary to achieve the unity goal with storage to maintain peak power through the night. A necessity of storing summer derived energy for the winter is noted, as is a substantial unit cost of power delivery reduction through the use of sodium-sulfur batteries. Site dependent studies were carried out for locations in Missouri, Nevada, and California, showing a significant cost of power increase for the MO site. Finally, it is concluded that maximum energy storage is not economical, while extra winter collectors are. M.S.K.

A82-24626 // Performance evaluation for a jet pump solar cooling system. F. Zeren and R. E. Holmes (Texas A & M University, College Station, TX). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-30.* 8 p. 20 refs. Members, $2.00; nonmembers, $4.00. Research supported by the Texas Energy and Natural Resources Advisory Council.

Features and performance of a solar flat-plate powered jet pump building cooling system are presented, along with a computer model of the system. Freon-12 is both primary and secondary fluid, and is mixed in the jet pump for routing through a condenser, after which separation occurs and fluid is routed back through the collectors and back to the room cooling loop. Thermodynamic properties of the Freon-12 coolant are incorporated into the computer model, along with weather data for the test program in College Station, TX. The

condenser, collector, and evaporator temperatures were found to be most important in the functioning of a jet pump cooling system, with a collector temperature range of 170-210 F providing the best performance. Lower condenser temperatures were found to increase the performance efficiency and minimize the required collector area. M.S.K.

A82-24827 # Methodology to determine cost and performance goals for active solar cooling systems. M. L. Warren and M. Wahlig (California, University, Berkeley, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-32.* 6 p. 13 refs. Members, $2.00; nonmembers, $4.00. Contract No. W-7405-eng-48.

Systems analysis is used to calculate the 20 yr. present value of energy savings of solar cooling systems located in Texas, Arizona, Florida, and Washington, DC, and methods of solar system development to meet the cost goals of economic operation are outlined. Solar cooling systems are projected to begin commercial entry in 1986 and reach 20% of the total cooling market by the year 2000, producing 0.14 quads of displaced energy. A numerical simulation was carried out for both residential and commercial solar cooling units with consideration for system cost goals, cost goals per unit collector area, and the cost goals per ton of cooling. System size was targeted as a 3 ton residential chiller and a 25 ton commercial absorption cooling unit. The costs for volume production are provided, along with trends for an incrementally decreasing need for tax incentives, ending in about 1994. M.S.K.

A82-24628 * # Experimental simulation of latent heat thermal energy storage and heat pipe thermal transport for dish concentrator solar receiver. R. Narayanan, W. F. Zimmerman (General Electric Co., Advanced Energy Programs Dept., Cincinnati, OH), and P. T. Y. Poon (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/Sol-34.* 6 p. 7 refs. Members, $2.00; nonmembers, $4.00. Research sponsored by the U.S. Department of Energy; Contract No. JPL-955388.

Test results on a modular simulation of the thermal transport and heat storage characteristics of a heat pipe solar receiver (HPSR) with thermal energy storage (TES) are presented. The HPSR features a 15-25 kWe Stirling engine power conversion system at the focal point of a parabolic dish concentrator operating at 827 C. The system collects and retrieves solar heat with sodium pipes and stores the heat in NaF-MgF2 latent heat storage material. The trials were run with a single full scale heat pipe, three full scale TES containers, and an air-cooled heat extraction coil to replace the Stirling engine heat exchanger. Charging and discharging, constant temperature operation, mixed mode operation, thermal inertial, etc. were studied. The heat pipe performance was verified, as were the thermal energy storage and discharge rates and isothermal discharges. M.S.K.

A82-24867 † 200-W solar photoelectric system based on AlGaAs heterostructure solar cells and mirror concentrators (Solnechnaia fotoelektricheskaia ustanovka moshchnost'iu 200Vt na osnove AlGaAs-geterofotoelementov i zerkal'nykh kohtsentratorov). Zh. I. Alferov, V. M. Andreev, Kh. K. Aripov, V. R. Larionov, and V. D. Rumiantsev (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *Geliotekhnika*, no. 6, 1981, p. 3-6. In Russian.

A 200-W solar system is described which uses nGaAs-pGaAs-pAl(x)Ga(1-x)As heterostructure cells, with an AlGaAs layer thickness of 25-30 microns. The concentrators used in the system are parabolic mirrors with a 50-cm focus. Results on the load volt-ampere characteristics for an individual module and for the system as a whole are presented. It is concluded that it should be possible to significantly increase the output power of such systems. B.J.

A82-24868 † New possibilities for the development and optimization of cascade-type solar cells (O novykh vozmozhnostiakh postroeniia i optimizatsii kaskadnykh solnechnykh elementov). M. B. Kagan and T. L. Liubashevskaia (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 6, 1981, p. 7-15. 16 refs. In Russian.

Various aspects of the development of cascade-type solar cells are discussed, including the optimal combination of semiconductor materials and limits on the efficiency of cascade systems; and the development of cascade cells on the basis of optimized heterostructures. Particular attention is given to two cascade-type systems: the GaAs-Ge (pGa/1-x/Al/x/As-pGaAs-nGaAs-nGe-pGe) system, and the three-cascade Ga(1-x)Al(x)-GaAs-Ge system. B.J.

A82-24869 † Choice of design parameters for prism-type solar concentrators (Vybor konstruktivnykh parametrov prizmennykh kontsentratorov solnechnoi energii). E. V. Tver'ianovich (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 6, 1981, p. 16-19. In Russian.

After a brief discussion of the operation of prism-type concentrators, the paper examines the choice of design parameters for them. Attention is given to such design parameters as the type of prism concentrator, the concentrator factor, the material, and the prism dimensions. B.J.

A82-24870 † Investigation of the thermal-engineering characteristics of a solar collector with a selective coating and vacuum heat-insulation (Issledovanie teplotekhnicheskikh kharakteristik solnechnogo kollektora s selektivnym pokrytiem i vakuumnoi teploizoliatsiei). T. Baimatov, N. Ch. Dursunov, G. Ia. Umarov, and U. Kh. Gaziev (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 6, 1981, p. 25-27. 7 refs. In Russian.

Experimental results are presented on the characteristics of a solar collector with a selective coating and vacuum heat-insulation. The maximum temperature of the heat-transfer agent at the collector output was 131 C; the output power density was 320 W/sq m for an emissivity of the transparent screen of 0.9; the emissivity of the receiver with the selective coating was 0.1; the absorption coefficient of the receiver was 0.9; the maximum temperature drop at the ends of the heat exchangers was 10 C. The use of an aluminum foil placed below the receiver increased the temperature of the heat-transfer agent at the collector output by 10-13 C. B.J.

A82-24871 † Investigation of the natural-climatic aging of the reflective films of mirrors by an electrical method (Issledovanie estestvenno-klimaticheskogo stareniia otrazhaiushchikh plenok zerkal elektricheskim metodom). A. Ismanzhanov, L. A. Dubrovskii, and R. A. Zakhidov (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). *Geliotekhnika*, no. 6, 1981, p. 37-40. 6 refs. In Russian.

Tests were performed to evaluate the natural-climatic aging of reflective aluminum films for solar mirrors. Electrical-resistance measurements were made on unprotected aluminum films and films protected by SiO(x), SiO2, Al2O3, and lacquer coatings. This made it possible to determine the amount of age-related damage experienced by the reflective films, and, in particular, to examine the transition of the film from a matrix type system (where the undamaged part of the film serves as the matrix) to a statistical type system. B.J.

A82-24940 A new look at the discrete ordinate method for radiative transfer calculations in anisotropically scattering atmospheres. II - Intensity computations. K. Stamnes and H. Dale (Alaska, University, Fairbanks, AK). *Journal of the Atmospheric Sciences*, vol. 38, Dec. 1981, p. 2696-2706. 9 refs. NSF Grants No. ATM-79-23266; No. ATM-79-26406.

The recently developed matrix method to solve the discrete ordinate approximation to the radiative transfer equation in plane parallel geometry is extended to compute the full azimuthal dependence of the intensity. Comparing computed intensities with those obtained by other established methods, it is found that for phase functions typical of atmospheric haze 32 streams are sufficient for better than 1% agreement, while 16 streams yield an accuracy of about 1-5% except for angles close to the forward and backward directions for which the error is about 10-15%. The results of the intensity computations are summarized by presenting three-dimensional stack plots of the intensity as a function of polar and azimuthal angles. (Author)

A82-25110 **Asymmetric second-stage concentrators.** E. M. Kritchman (Chicago, University, Chicago, IL). *Applied Optics*, vol. 21, Mar. 1, 1982, p. 870-873. 7 refs.

It is demonstrated that asymmetric ideal second-stage concentrators may be designed for any given concentrator and absorber (within certain limits) and hence may be used in the field of solar energy to eliminate the shading of the primary by the secondary stage. An application involving an off-acceptance angle concentrator in which the primary is not shaded by the secondary from the illuminating source is examined. V.L.

A82-25223 **Solar cells: Operating principles, technology, and system applications.** M. A. Green (New South Wales, University, Kensington, Australia). Englewood Cliffs, NJ, Prentice-Hall, Inc., 1982. 288 p. 153 refs. $28.

Solar cell theory, materials, fabrication, design, modules, and systems are discussed. The solar source of light energy is described and quantified, along with a review of semiconductor properties and the generation, recombination, and the basic equations of photovoltaic device physics. Particular attention is given to p-n junction diodes, including efficiency limits, losses, and measurements. Si solar cell technology is described for the production of solar-quality crystals and wafers, and design, improvements, and device structures are examined. Consideration is given to alternate semiconductor materials and applications in concentrating systems, storage, and the design and construction of stand-alone systems and systems for residential and centralized power generation. M.S.K.

A82-25237 **Selective optical surfaces for solar energy converters.** M. M. Koltun (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). New York, Allerton Press, Inc., 1981. 244 p. 213 refs. Translation. $42.50.

Optical surfaces and coatings with selective spectral characteristics are studied with reference to solar cells and arrays for power generation in space and on the ground. Detailed optical, electrical, and thermal properties are given for solar energy concentrators, radiators, transparent thermoreflective windows, and thermal collectors. It is shown that selective surfaces make it possible to collect up to 90% of the energy contained in the incident solar radiation and to increase the efficiency of photovoltaic generators by 50%. The service life of solar arrays can be increased through the use of selective coatings by a factor of up to several hundreds. V.L.

A82-25501 **Optimization of the functional domain of flat plate collectors (Recherche du meilleur domaine d'utilisation des capteurs solaires plans usuels).** G. Ritoux and J.-L. Irigaray (Clermont-Ferrand II, Université, Aubière, Puy-de-Dôme, France). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 8-11. In French.

The variations of the extracted heat flux as function of the temperature of the heat transfer fluid in black and selective surface solar collectors are examined. The heat flux is calculated based on the difference of the initial to the stage of thermal equilibrium of the fluid. A nonlinear system of equations is developed and solved by a fast, iterative method to obtain the equilibrium temperatures. It is found that more flux can be extracted from the solar heat by a collector with only one glass cover than with more than one cover. The captured flux is proportional to the coefficient of transmission of the glass coverings, to the coefficient of absorption of the collector, and to the incident flux. Black painted surfaces were more absorbent than selective surfaces, and highest collection efficiencies were displayed by low temperature collectors. Charts of effective uses of the respective types of collectors for heating swimming pools, hot water, home heat, and for refrigeration and air-conditioning are provided. M.S.K.

A82-25503 **Use of a photodiode array for the analysis of the solar profile intensity in concentrating collectors.** C. Bellecci, G. Garofalo, C. Pontiggia (Calabria, Università, Cosenza, Italy), G. A. Rottigni, and R. Visentin (Genova, Università, Genoa, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 29-32.

A photodiode array for measuring the light distribution in a cross section of the focal zone of solar concentrator assembly is presented. The photosensors are coupled to electronic circuits for conversion into a display on a CRT screen. The array consists of 24 photodiodes mounted linearly on a 10 cm strip, with each photodiode having an effective area of 9 sq mm. Light attenuators ranging up to 10,000 have been mounted on the photodiodes by vacuum deposition to avoid excess currents in the array, and circuitry switching allows photon counting for formation of histograms representing all 24 photodiodes. Examples are provided for applications with a biaxis parabolic mirror featuring aspirated reflecting lamina and a parabolic trough concentrator with a 2.5 m aperture. M.S.K.

A82-25504 **REA, a solar breeder reactor with high energetic enhancement factor - Technoeconomic analysis.** R. Visentin (Calabria, Università, Cosenza, Italy). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 33-36.

Noting that the main character of a renewable energy system is a higher energy yield than the energy necessary to produce the system, a solar breeder installation, REA, is described. A numerical analysis is presented which determines the thermodynamic and climatological constraints which bound a satisfactory energy payback for a solar system. REA is composed of 20 linear parabolic concentrator collectors, each 52 m long, with 125 sq m collecting area. The system produces both electricity and thermal power, and the energy costs of the materials and processes needed to fabricate the system are compared to the energy payback of the system over its lifetime and the possibility of utilizing the materials at the end of the plant life. The comparison is made on the basis of 0.85 kW/sq m for at least one hr/day, showing a satisfactory energy payback with less than a total of 1000 hr insolation/yr. M.S.K.

A82-25505 **Solar multiple purpose power plant in modular superlight weight construction.** J. Kleinwachter. *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique*, 2nd Semester, 1981, p. 37-41. 9 refs.

The use of aluminized membranes to form low-cost low-weight solar parabolic concentrators for thermal power production is described, including the practice of covering the concentrators with a transparent enclosure for protection from the weather. Stretching the plane mirror foils over a hollow, drum-shaped body permits production of a slight under- or overpressure inside the drum to deform the foil into a suitable approximation of a parabolic dish. Electric fields and magnetic field have yielded results equivalent to the pneumatic method, and fluorine-based synthetics for the foil are showing the best durability and forming characteristics. Applications involving 3 m and 10 m dishes and a Sterling engine have produced 3.7 and 40.7 kWt at the hot spot, respectively. The optical performance is summarized as an 800 W/sq m flux reduced to 720 W/sq m after traversing the enclosure, and 518 W/sq m reflected from the paraboloid. M.S.K.

A82-25548 **Solar cell performance with an inhomogeneous areal distribution but constant number of recombination centers.** R. O. Bell (Mobil Tyco Solar Energy Corp., Waltham, MA). *Solid-State Electronics*, vol. 25, Feb. 1982, p. 175, 176.

The performance of a solar cell is dependent not only on the number of recombination sites but also on their areal distribution. Calculations show that, with a fixed number of sites, an inhomogeneous distribution can produce a cell with a higher efficiency than one in which the same centers are uniformly distributed. (Author)

A82-25664 * **Solar-pumped electronic-to-vibrational energy transfer lasers.** W. L. Harries (Old Dominion University, Norfolk, VA) and J. W. Wilson (NASA, Langley Research Center, Hampton, VA). *Space Solar Power Review*, vol. 2, no. 4, 1981, p. 367-381. 12 refs. Grant No. NsG-1568.

The possibility of using solar-pumped lasers as solar energy converters is examined. The absorbing media considered are halogens or halogen compounds, which are dissociated to yield excited atoms, which then hand over energy to a molecular lasing medium. Estimates of the temperature effects for a Br2-CO2-He system with He as the cooling gas are given. High temperatures can cause the lower energy levels of the CO2 laser transition to be filled. The inverted populations are calculated and lasing should be possible. However, the efficiency is less than 0.001. Examination of other halogen-molecular lasant combinations (where the rate coefficients

are known) indicate efficiencies in all cases of less than 0.005.
(Author)

A82-25738 Photoelectrochemical performance of ZnSe/CdSe thin film electrodes in aqueous polysulfide electrolyte. M. A. Russak and J. Reichman (Grumman Aerospace Corp., Research Dept., Bethpage, NY). *Electrochemical Society, Journal*, vol. 129, Mar. 1982, p. 542-545. 19 refs. Contract No. XP9-8002-8.

ZnSe/CdSe heterostructure thin film electrodes were produced by ternary elemental vacuum evaporation. These electrodes behaved similarly to MIS type devices when tested photoelectrochemically. Auger depth profiling indicated the formation of an electrochemically generated ZnS interface layer that provided an enhanced open-circuit voltage compared to CdSe alone. Efficiencies as high as 5.4% under simulated AM2 conditions were recorded for these electrodes.
(Author)

A82-25739 Study of stabilization and surface recombination on n-GaP photoelectrodes - Mechanisms and interrelation. D. Vanmaekelbergh, W. P. Gomes, and F. Cardon (Gent, Rijksuniversiteit, Ghent, Belgium). *Electrochemical Society, Journal*, vol. 129, Mar. 1982, p. 546-550. 10 refs.

The competition has been studied between three processes occurring with photogenerated holes at the n-GaP/aqueous electrolyte interface, i.e., reaction with Fe(2+) ions, reaction with GaP itself, and surface recombination. The experimental method used was the rotating ring-disk technique. The influence of the reducing agent concentration, of the light intensity, and of the electrode potential was investigated. The results can be interpreted on the basis of models, in which the stabilization process, and under certain circumstances also the recombination process, takes place through surface intermediates of the photoanodic decomposition reaction.
(Author)

A82-25741 Porous silicon oxide anti-reflection coating for solar cells. A. Prasad, S. Balakrishnan, S. K. Jain, and G. C. Jain (National Physical Laboratory of India, New Delhi, India). *Electrochemical Society, Journal*, vol. 129, Mar. 1982, p. 596-599. 12 refs.

A very useful anti-reflection (AR) coating, having characteristics quite similar to silicon monoxide, has been grown on P(+)N solar cells by a simple technique. ESCA, infrared absorption, and ellipsometry analysis of the films indicated that they consist of silicon oxide with some bound hydrogen. Some added advantages of the new AR coating are described.
(Author)

A82-25782 A study of water electrolysis with photovoltaic solar energy conversion. C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 4, 1982, p. 287-310. 7 refs.

The performance of the hydrogen production system consisting of the photovoltaic array and the water electrolysis unit is studied. The results of the calculation are compared with available experimental data and the performance of a hydrogen production plant by means of photovoltaic solar energy conversion is determined for two typical locations. A method for the estimation of the power matching conditions of the system solar array electrolysis unit is formulated to allow conclusions of general validity.
(Author)

A82-25973 † Automatic control of solar power plants (Avtomaticheskoe upravlenie solnechnymi elektrostantsiiami). V. S. Ermakov and V. M. Dubilovich. *Inzhenerno-Fizicheskii Zhurnal*, vol. 42, Feb. 1982, p. 320-327. In Russian.

The automatic control of the heliostat field of a 200-MW solar power plant is discussed. The advantages of the decentralized control principle with the solution of a number of individual problems in a single control center are emphasized. The basic requirements on heliostat construction are examined, and possible functional schemes for the automatic control of a heliostat field are described. It is proposed that groups of heliostats can be controlled from a single center and on the basis of a single algorithm.
B.J.

A82-26022 Optimal geometries of plane mirror solar collectors. H. P. Garg, J. K. Sharma, and A. Dang (Indian Institute of Technology, New Delhi, India). *International Journal of Energy Research*, vol. 6, Jan.-Mar. 1982, p. 11-20. 5 refs.

This paper presents an analytical study of a stationary plane mirror solar concentrator. It is composed of an array of east-west oriented trapezoidal channels with two sided reflecting walls and a tubular absorber as a receiver at the base. The most practical design parameters for a trough like concentrator have been analyzed and identified. The one- and two-faceted plane side wall configurations with tubular receiver at the base of the trough have been studied in detail. It has been concluded that large savings in reflecting surfaces are possible while sacrificing some reduction in concentration. A theoretical prediction for the dependence of absorber efficiency on temperature has been obtained.
(Author)

A82-26024 Thermodynamic analysis of solar thermochemical energy absorption. O. M. Williams (Australian National University, Canberra, Australia). *International Journal of Energy Research*, vol. 6, Jan.-Mar. 1982, p. 61-71. 12 refs.

Thermochemical energy conversion is analyzed on a thermodynamic basis, with special attention given to obtaining guidance on solar thermochemical absorber design at an early stage of development (when technical and cost information is often unreliable). A previously used thermodynamic equivalence technique that is equally applicable to both endothermic and exothermic reactions has been developed to the point where it gives a clear insight into all sources of heat and work. The method is applied to separating those endothermic reactions of which ammonia dissociation is a prime example. A reversibility ratio is defined as the ratio of irreversible work to reversible work. It is shown that in a practical solar thermochemical absorber design, the reversibility ratio should be minimized, corresponding to reaction temperature minimization and thus to lower energy losses and to potential for use of lower cost reactor materials and more active catalysts.
C.R.

A82-26330 A new look at long term collector performance and utilizability. D. L. Evans, T. T. Rule, and B. D. Wood (Arizona State University, Tempe, AZ). *Solar Energy*, vol. 28, no. 1, 1982, p. 13-23. 27 refs. Contract No. DE-AC03-79CS-30203.

A simple technique has been developed to calculate monthly collection efficiency or monthly utilizability for solar thermal flat-plate collectors. It is applicable to south facing tilted collectors operating with a fixed fluid inlet temperature although extensions to other more generalized uses of utilizability are discussed. The heart of the technique is an empirically determined performance map that makes possible quick evaluations of changes in collector design, geographic location and collector inlet temperature. The collector input variables are those that are commonly measured in most thermal test procedures; geographic input variables are the mean monthly temperature and the Liu and Jordan clearness factor. The procedure was developed for monthly optimum fixed tilts but a simple correction can be made to incorporate arbitrary monthly fixed tilts. The method gives good results compared to long term hourly simulation and makes it possible to determine the operating conditions under which collector performance begins to depend on site-to-site solar radiation/weather variability and the uncertainties that can be expected from its use.
(Author)

A82-26331 Black cobalt selective coatings by spray pyrolysis for photothermal conversion of solar energy. C. Choudhury and H. K. Sehgal (Indian Institute of Technology, New Delhi, India). *Solar Energy*, vol. 28, no. 1, 1982, p. 25-31. 13 refs.

A82-26332 Convective heat transfer in vee-trough linear concentrators. B. A. Meyer, J. W. Mitchell, and M. M. El-Wakil (Wisconsin, University, Madison, WI). *Solar Energy*, vol. 28, no. 1, 1982, p. 33-40. 9 refs. Research supported by the U.S. Department of Energy and University of Wisconsin.

Natural convection heat-transfer coefficients have been experimentally determined for trough-type collectors. The effects of Rayleigh number, tilt angle, and ideal concentration ratio on the Nusselt number have been experimentally determined over ranges representative of collector operation. The Rayleigh number range tested was up to 10,000,000, the tilt angle was varied from 30-90 deg and ideal concentration ratios of 2, 3, 4 and 5 were tested. The experimental results are supported by finite element solutions to the governing equations. A method of extending the results to truncated

trough collectors and CPC collectors is suggested. The convective losses are compared to those for conventional flat plate collectors. The critical Rayleigh number increases with concentration ratio. Nusselt number increases more rapidly at high concentration ratio than at low values. Correlation equations are developed over the range of parameters tested. These results are useful to designers of collectors of this type, and allow estimation of the thermal losses during operation. (Author)

A82-26333 Solar collector based on whisker-shaped oxides grown on metallic substrates. L. R. Chapman (Union Carbide Corp., Nuclear Div., Oak Ridge, TN) and G. L. Vaneman (GM Research Laboratories, Warren, MI). *Solar Energy*, vol. 28, no. 1, 1982, p. 77-79. 19 refs.

A82-26334 Tert-butyl alcohol as a heat sink substance for solar thermoelectric generators. S. Wenham and H. J. Goldsmid (New South Wales, University, Kensington, Australia). *Solar Energy*, vol. 28, no. 1, 1982, p. 81.

A82-26335 An evaluation of a transverse slatted flat plate collector. K. I. Guthrie and W. W. S. Charters (Melbourne, University, Parkville, Victoria, Australia). *Solar Energy*, vol. 28, no. 2, 1982, p. 89-97. 18 refs.

The design, fabrication, and experimental tests with parallel slat convection suppression devices for eliminating convective heat losses in solar flat plate collectors are detailed. Consideration is given to numerical modelling the natural convection in an inclined cell, and laboratory tests were made to compare collectors with and without a glass slat honeycomb. Further outdoor tests were made on the same plates at angles of 33, 40, and 60 deg in Melbourne, Australia. Significant improvements in the collector performance were found with the use of the slat honeycomb, with values of up to 40% with collectors without selective absorbing surfaces. The slatted collector required reorientation every two months to compensate for the interception of the oncoming radiation by the absorber slats. Further tests of materials suitable for the slats are recommended. M.S.K.

A82-26337 Dynamic analysis and control of a solar power plant. I - Dynamic analysis and operation criteria. II - Control system design and simulation. C. Maffezzoni and F. Parigi (Ente Nazionale per l'Energia Elettrica, Centro Ricerca di Automatica, Milan, Italy). *Solar Energy*, vol. 28, no. 2, 1982, p. 105-128. 14 refs. Research supported by the European Economic Community.

A82-26338 Decay of thermal stratification in a water body for solar energy storage. Y. Jaluria (Rutgers University, New Brunswick, NJ) and S. K. Gupta (Indian Institute of Technology, Delhi, India). *Solar Energy*, vol. 28, no. 2, 1982, p. 137-143. 10 refs.

A82-26468 Duplication of radome aerodynamic heating using the Central Receiver Test Facility solar furnace. R. K. Frazer (Johns Hopkins University, Laurel, MD). In: Symposium on Electromagnetic Windows, 15th, Atlanta, GA, June 18-20, 1980, Proceedings. Atlanta, GA, Georgia Institute of Technology, 1980, p. 112-116. 5 refs.

An experiment has been conducted that used the solar furnace at the Central Receiver Test Facility (CRTF) in Albuquerque, NM, to create flight-like temperatures in three supersonic missile radomes. The radomes tested have a von Karman profile, are made of Pyroceram 9606 about 0.25 in. thick, and have a fineness ratio of 2.1 with a base diameter of 13.5 in. The purpose of this effort was to measure the changes in radome boresight error (BSE) caused by aerodynamic heating. This paper describes the thermal aspects of the experiment, including the facility selection, heat flux survey measurements, temperature measurements made on a calibration radome, and calibration of optical pyrometers. (Author)

A82-26515 Heat transfer coefficient for constant flow solar collector/storage systems. S. Singh, S. S. Bhardwaj, and N. K. Bansal (Indian Institute of Technology, New Delhi, India). *Applied Energy*, vol. 10, Feb. 1982, p. 151-158.

A82-26807 Amorphous silicon p-i-n solar cells fabricated by reactive sputtering. T. D. Moustakas and R. Friedman (Exxon Corporate Research Laboratory, Linden, NJ). *Applied Physics Letters*, vol. 40, Mar. 15, 1982, p. 515-517. 10 refs. Contract No. XZ-9-9219.

The fabrication of indium-tin-oxide p-i-n amorphous silicon solar cells by the reactive sputtering method is reported. The solar cells exhibit a power conversion efficiency of 4.0% under AM1 illumination, and evidence is presented that the efficiency of the devices can be further improved to values comparable to those of glow discharge amorphous silicon. The diode properties of the devices are investigated by studying the dark I-V or photocurrent-photovoltage characteristics, and the junction characteristics are discussed. D.L.G.

A82-26950 Thermal energy storage for solar power generation - State of the art. K. N. Shukla (Indian Space Research Organization, Vikram Sarabhai Space Centre, Trivandrum, India). *Heat Transfer Engineering*, vol. 3, Oct.-Dec. 1981, p. 62-72. 46 refs.

High temperature storage for applications in solar-thermal electric systems is considered. Noting that thermal storage is in either the form of latent, sensible or chemically stored heat, sensible heat storage is stressed as the most developed of the thermal storage technologies, spanning direct heating of a storage medium from 120-1250 C. Current methods involve solids, packed beds, fluidized beds, liquids, hot water, organic liquids, and inorganic liquids and molten salts. Latent heat storage comprises phase-change materials that move from solid to liquid with addition of heat and liquid to solid with the removal of heat. Metals or inorganic salts are candidates, and the energy balances are outlined. Finally, chemical heat storage is examined, showing possible high energy densities through catalytic, thermal dissociation reactions. M.S.K.

A82-27010 Effect of phosphorous and boron impurities on amorphous silicon solar cells. T. D. Moustakas, R. Friedman, and B. R. Weinberger (Exxon Corporate Research Laboratory, Linden, NJ). *Applied Physics Letters*, vol. 40, Apr. 1, 1982, p. 587, 588. 6 refs. Contract No. XZ-9-9219.

The effect of dopant impurities (P,B) on the performance of sputtered alpha-SiH(x) solar cells has been investigated. It is found for example, that during the deposition of the N(+) layer of N(+)-I-Pt Schottky barrier structures, the chamber is contaminated with phosphorous which subsequently degrades the intrinsic film. This effect may be eliminated by prolonged pumping of the chamber between N(+) and I layer depositions or by 'compensating' the effects of phosphorus in the I layer through the intentional addition of low levels of boron. (Author)

A82-27012 Band tail recombination limit to the output voltage of amorphous silicon solar cells. T. Tiedje (Exxon Corporate Research Laboratory, Linden, NJ). *Applied Physics Letters*, vol. 40, Apr. 1, 1982, p. 627-629. 14 refs.

Recombination mediated by band tail states is shown to substantially reduce the maximum achievable output voltage in amorphous silicon hydride solar cells. The maximum open circuit voltage calculated from measured density of states parameters and reasonable estimates for the localized state capture rates is 1.0 + or - 0.1 V. (Author)

A82-28170 Concentration of solar radiation by white painted transparent plates. G. Smestad and P. Hamill (Santa Clara, University, Santa Clara, CA). *Applied Optics*, vol. 21, Apr. 1, 1982, p. 1298-1306. 10 refs.

A flat-plate solar concentrator device is described which consists of a white-painted transparent plate, with a photovoltaic cell fixed to an unpainted area on the bottom of the plate so that light scattering off the white material is either lost or directed to the solar cell. Concentration factors of up to 1.9 times the incident solar flux have been achieved using white clays. Such factors approximate those predicted by theory for the parameters investigated. A theory of the operation of the device is developed, by means of which suggestions for system optimization are made. The concentrator's performance is independent of incidence angle, so that it requires no tracking system; it will concentrate on a cloudy day, and is easy to produce. O.C.

A82-28171 Ideal second stages in tandem with parabolic concentrators. E. M. Kritchman (Chicago, University, Chicago, IL).

Applied Optics, vol. 21, Apr. 1, 1982, p. 1307-1309. 15 refs.

It is shown through the derivation of expressions for the concentration capability of both point and linear focus parabolic reflectors, and their extension to include ideal, second-stage concentration, that the ultimate concentration of a primary reflector alone achieves only 1/2 of the ideal limit in two-dimensional, line focus geometry and 1/4 in three-dimensional, point focus geometry. By contrast, the two-stage configurations suggested for both parabolic concentrator geometries are shown to approach the ideal limit at large f/Nos. O.C.

A82-28385 Fundamentals and applications of solar energy. Part 2. Edited by I. H. Faraq (New Hampshire, University, Durham, NH) and S. S. Mehlheimer (Clemson University, Clemson, SC). *AIChE Symposium Series*, vol. 77, no. 210, 1981. 103 p.

Applications of techniques of chemical engineering to the development of materials, production methods, and performance optimization and evaluation of solar energy systems are discussed. Solar thermal storage systems using phase change materials, liquid phase Diels-Alder reactions, aquifers, and hydrocarbon oil were examined. Solar electric systems were explored in terms of a chlorophyll solar cell, the nonequilibrium electric field effects developed at photoelectrode/electrolyte interfaces, and designs for commercial scale processing of solar cells using continuous thin-film coating production methods. Solar coal gasification processes were considered, along with multilayer absorber coatings for solar concentrator receivers, solar thermal industrial applications, the kinetics of anaerobic digestion of crop residues to produce methane, and a procedure for developing a computer simulation of a solar cooling system. M.S.K.

A82-28386 A novel chlorophyll solar cell. J. C. Ludlow (West Virginia University, Morgantown, WV). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 22-26. 9 refs.

The photosynthetic process is reviewed in order to produce a design for a chlorophyll solar cell. In a leaf, antenna chlorophyll absorbs light energy and conducts it to an energy trap composed of a protein and two chlorophyll molecules, which perform the oxidation-reduction chemistry. The redox potential of the trap changes from 0.4 to -0.6 V, which is sufficient to reduce nearby molecules with redox potentials in that range. The reduction occurs by transfer of an electron, and a chlorophyll solar cell would direct the transferred electron to a current carrier. Chlorophyll antenna and traps are placed on a metallic support immersed in an electron acceptor solution, and resulting electrons from exposure to light are gathered by a metallic current collector. Spinach chlorophyll extracted, purified, and applied in a cell featuring a Pt collector and an octane water emulsion resulted in intensity independent voltages. M.S.K.

A82-28387 Theoretical study of absorbed solar energy in multi-layer absorber coatings for receivers of solar concentrators. I - Radiation transfer analysis. I. S. Taha, M. A. Darwish, and M. M. Elsayed (King Abdulaziz University, Jeddah, Saudi Arabia). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 27-34.

An analysis of a model of short wave radiation interaction with a coating composed of a microlayer of low emittance substrate covered by a semiconductor layer and two absorbing microlayers is presented. The work is intended to maximize short wave radiation absorption in concentrating solar collector applications. Using multiple layers is noted to permit options of absorptance and material thickness. A numerical model is developed for a multilayer coating with two nonreflecting outermost coatings. Governing equations and boundary conditions are defined for behavior under a monochromatic flux. A solution is formulated for predicting the total amount and distribution of the energy absorbed in the outer layers, integrated over the spectrum of the incident flux. Further consideration is given to compromises in energy gains by absorption and long wave radiation losses from the coatings, in addition to the necessity of expanded studies of the different optical properties of selective surface coatings. M.S.K.

A82-28388 Solar coal gasification - Plant design and economics. W. R. Aiman, C. B. Thorsness, and D. W. Gregg (California, University, Livermore, CA). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 36-46. 12 refs. Contract No. W-7405-eng-48.

A plant design and economic analysis is presented for solar coal gasification (SCG). Coal pyrolysis and char gasification to form the gasified product are reviewed, noting that the endothermic gasification reactions occur only at temperatures exceeding 1000 K, an energy input of 101-136 kJ/mol of char reformed. Use of solar heat offers the possibility of replacing fuels needed to perform the gasification and the oxygen necessary in order to produce a nitrogen-free product. Reactions, energetics, and byproducts from the gasification of subbituminous coal are modeled for a process analysis code used for the SCG plant. Gas generation is designed to occur in a unit exposed to the solar flux focus from a heliostat field. The SCG gas would have an H2 content of 88%, compared to the 55% offered by the Lurgi process. Initial capital costs for the SCG plant are projected to be 4 times those with the Lurgi process, with equality being achieved when coal costs $4/gJ. M.S.K.

A82-28389 A continuous two stage solar coal gasification system. V. K. Mathur, R. W. Breault (New Hampshire, University, Durham, NH), S. Lakshmanan, F. K. Manasse, and V. Venkataramanan. *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 47-54. 12 refs.

The characteristics of a two-stage fluidized-bed hybrid coal gasification system to produce syngas from coal, lignite, and peat are described. Devolatilization heat of 823 K is supplied by recirculating gas heated by a solar receiver/coal heater. A second-stage gasifier maintained at 1227 K serves to crack remaining tar and light oil to yield a product free from tar and other condensables, and sulfur can be removed by hot clean-up processes. CO is minimized because the coal is not burned with oxygen, and the product gas contains 50% H2. Bench scale reactors consist of a stage I unit 0.1 m in diam which is fed coal 200 microns in size. A stage II reactor has an inner diam of 0.36 m and serves to gasify the char from stage I. A solar power source of 10 kWt is required for the bench model, and will be obtained from a central receiver with quartz or heat pipe configurations for heat transfer. M.S.K.

A82-28390 Commercial-scale process design for thin-film solar cells. T. W. F. Russell, B. N. Baron, and R. E. Rocheleau (Delaware, University, Newark, DE). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 70-77. 14 refs.

Process and manufacturing costs for commercial-scale production of thin-film solar cells are examined from the viewpoint of the chemical process industry, with emphasis on CdS/Cu2S cells. The cells comprise opaque contact, collector/converter, absorber/generator, transparent contact, and encapsulation/antireflective coating layers. Each layer is deposited as a separate unit operation, through either continuous or batch processing methods. The scale-up of laboratory-verified cell manufacturing steps to commercial processing is detailed from the choice of a Zn-plated copper foil substrate to the bonding of a 1/16 in. tempered glass protective layer with polyvinyl butyral. The total product cost is calculated as a sum of raw materials, utilities, labor, and capital investment costs, using a cost/W for a 1 GW plant. Continuous processing results in a $0.50/W cell with raw materials accounting for 38% of the total product cost. M.S.K.

A82-28392 Computer simulation of solar cooling. M. M. Elsayed, I. S. Taha, and M. A. Darwish (King Abdulaziz University, Jeddah, Saudi Arabia). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 86-96. 9 refs.

A simplified technique for developing a simulation for analysis of a solar-powered H2O/LiBr absorption cooling system is described. The system considered comprises a flat plate collector, a fluid-filled hot storage tank, an absorber which contains cooling water weak solution, and LiBr closed loops, a heat exchanger to transfer heat between the strong and weak solutions, a generator powered by hot water from the storage tank, a condenser, evaporator, a strong mixture and refrigerant expansion valves. Governing equations are defined for the properties of the binary solution, of the refrigerant, the solar flux, and the air temperature. The numerical performance simulation is detailed for sample winter and summer days, including heat and mass balances. M.S.K.

A82-28498 **Efficient GaAs solar cells formed by UV laser chemical doping.** T. F. Deutsch, J. C. C. Fan, D. J. Ehrlich, G. W. Turner, R. L. Chapman, and R. P. Gale (MIT, Lexington, MA). *Applied Physics Letters*, vol. 40, Apr. 15, 1982, p. 722-724. 10 refs. USAF-DARPA-Army-sponsored research.

GaAs p-n junctions have been formed by ArF - J XeF excimer laser radiation, which releases S atoms by the dissociation of H2S gas while simultaneously heating the substrate to allow incorporation of the S dopant. In addition to fabricating solar cells having AM1 efficiencies of 10.6% from these junctions, the process can produce doped GaAs layers with sheet resistances as low as 30 Ohms/square unit. This efficiency compares favorably with the 12% value obtained for ion-implanted, CW Nd:YAG laser-annealed GaAs solar cells of smaller area.

O.C.

A82-29499 **n-CuInSe2/polysulfide photoelectrochemical solar cells.** Y. Mirovsky and D. Cahen (Weizmann Institute of Science, Rehovot, Israel). *Applied Physics Letters*, vol. 40, Apr. 15, 1982, p. 727, 728. 15 refs. Research supported by the United States - Israel Binational Science Foundation.

Quantum efficiencies as high as 0.8-0.9 are exhibited by n-type single crystals of n-CuInSe2 in aqueous polysulfide solution, over the 600-1150 nm wavelength region, when used as photoanodes in photoelectrochemical cells. Photocurrents corresponding to values of 40 mA/sq cm under AM1 conditions of 100 mW/sq cm sunlight have been measured, and the stability testing of n-CuInSe2 photoanodes for the case of a 20,000 C/sq cm photocharge passage at short-circuit densities of 40 mA/sq cm have shown no deterioration of the measured photocurrents.

O.C.

N82-16475* National Aeronautics and Space Administration. Pasadena Office, Calif.

SOLAR HEATED FLUIDIZED BED GASIFICATION SYSTEM Patent

Shaik A. Qader, inventor (to NASA) (JPL, California Inst. of Technology, Pasadena) Issued 22 Sep. 1981 5 p Filed 15 May 1980 Supersedes N80-24747 (18 - 15, p 2002) Sponsored by NASA

(NASA-Case-NPO-15071-1; US-Patent-4,290,779; US-Patent-Appl-SN-150115; US-Patent-Class-48-89; US-Patent-Class-48-99; US-Patent-Class-126-438; US-Patent-Class-250-527) Avail: US Patent and Trademark Office CSCL 10A

A solar-powered fluidized bed gasification system for gasifying carbonaceous material is presented. The system includes a solar gasifier which is heated by fluidizing gas and steam. Energy to heat the gas and steam is supplied by a high heat capacity refractory honeycomb which surrounds the fluid bed reactor zone. The high heat capacity refractory honeycomb is heated by solar energy focused on the honeycomb by solar concentrator through solar window. The fluid bed reaction zone is also heated directly and uniformly by thermal contact of the high heat capacity ceramic honeycomb with the walls of the fluidized bed reactor. Provisions are also made for recovering and recycling catalysts used in the gasification process. Back-up furnace is provided for start-up procedures and for supplying heat to the fluid bed reaction zone when adequate supplies of solar energy are not available.

Official Gazette of the U.S. Patent and Trademark Office

N82-16490*# Spire Corp., Bedford, Mass.

DEVELOPMENT AND FABRICATION OF A SOLAR CELL JUNCTION PROCESSING SYSTEM

S. Bunker Oct. 1981 30 p refs Sponsored in part by DOE Prepared for JPL

(Contracts NAS7-100; JPL-955840)

(NASA-CR-163474; DOE/JPL-955840-81/7; JPL-9950-623; QR-10073-07; QR-7) Avail: NTIS HC A03/MF A01 CSCL 10A

A solar cell junction processing system was developed and fabricated. A pulsed electron beam for the four inch wafers is being assembled and tested, wafers were successfully pulsed, and solar cells fabricated. Assembly of the transport locks is completed. The transport was operated successfully but not with sufficient reproducibility. An experiment test facility to examine potential scaleup problems associated with the proposed ion implanter design was constructed and operated. Cells were implanted and found to have efficiency identical to the normal Spire implant process.

S.L.

N82-16491*# Motorola, Inc., Phoenix, Ariz. Semiconductor Group.

PROCESSING EXPERIMENTS ON NON-CZOCHRALSKI SILICON SHEET Final Report

R. A. Pryor, L. A. Grenon, N. G. Sakiotis, E. M. Pastirik, T. O. Sparks, and R. N. Legge Apr. 1981 221 p refs Sponsored in part by DOE Prepared for JPL

(Contract JPL-955844)

(NASA-CR-163473; DOE/JPL-955844-81/2; JPL-9950-624) Avail: NTIS HC A10/MF A01 CSCL 10A

A program is described which supports and promotes the development of processing techniques which may be successfully and cost-effectively applied to low-cost sheets for solar cell fabrication. Results are reported in the areas of process technology, cell design, cell metallization, and production cost simulation.

T.M.

N82-16492*# Boeing Engineering and Construction, Seattle, Wash. Solar Systems Group.

A CONCEPTUAL DESIGN STUDY OF POINT FOCUSING THIN-FILM SOLAR CONCENTRATORS Final Report

11 Nov. 1981 128 p refs Prepared for JPL

(Contract JPL-955804)

(NASA-CR-163472; JPL-9950-625) Avail: NTIS HC A07/MF A01 CSCL 10A

Candidates for reflector panel design concepts, including materials and configurations, were identified. The large list of candidates was screened and reduced to the five most promising ones. Cost and technical factors were used in making the final choices for the panel conceptual design, which was a stiffened steel skin substrate with a bonded, acrylic overcoated, aluminized polyester film reflective surface. Computer simulations were run for the concentrator optics using the selected panel design, and experimentally determined specularity and reflectivity values. Intercept factor curves and energy to the aperture curves were produced. These curves indicate that surface errors of 2 mrad (milliradians) or less would be required to capture the desired energy for a Brayton cycle 816 C case. Two test panels were fabricated to demonstrate manufacturability and optically tested for surface error. Surface errors in the range of 1.75 mrad and 2.2 mrad were measured.

T.M.

N82-16499# Mid-American Solar Energy Complex, Minneapolis, Minn.

PASSIVE-SOLAR MULTI-FAMILY CONCEPTS

Aug. 1981 88 p

(Contract DE-AC02-79CS-30150)

(DE82-000456; MASEC-PA-81-033) Avail: NTIS HC A05/MF A01

The potential for saving energy and money through the use of passive solar techniques in multi family buildings is examined. Seven designs for passive solar apartment/townhouse buildings are presented. Each design is described and illustrated. The buildings are sited in Indiana, Michigan, Missouri, Ohio, South Dakota, and Minnesota.

DOE

N82-16500# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

SIMPLE PREDICTIVE MODEL FOR PERFORMANCE OF DESICCANT BEDS FOR SOLAR DEHUMIDIFICATION

Robert S. Barlow Aug. 1981 7 p refs Presented at the Intern. Passive and Hybrid Cooling Conf., Miami Beach, Fla., 11-13 Nov. 1981; sponsored by the America Section of the International Solar Energy Society

(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE81-023606; SERI/TP-631-1329; CONF-811109-1) Avail: NTIS HC A02/MF A01

A computer model for the absorption/desorption process that predicts the performance of desiccant beds for solar regenerated dehumidification of passively cooled buildings is outlined. The model uses simple algebraic equations for steady state heat and mass exchangers. The validity and accuracy of the model is demonstrated. The physics of the adsorption process in two psychrometric process lines is discussed.

DOE

N82-16505# Sandia Labs., Albuquerque, N. Mex.

POTENTIAL FOR USING PARABOLIC TROUGH COLLECTORS TO SUPPLEMENT POWER CYCLE BOILERS

W. P. Schimmel, Jr. and L. L. Lukens 1981 17 p refs Presented at Winter Ann. Meeting of the ASME Technol. and Soc. Div., Washington, D.C., 15 Nov. 1981

(Contract DE-AC04-76DP-00789)
(SAND-81-0672C; CONF-811101-3) Avail: NTIS HC A02/MF A01

The advantage of such a system is that solar energy is used to heat the water in a steam Rankine cycle device up to the superheat regime, thus displacing the fossil fuel usually required. The temperature associated with this portion of the power cycle is typically on the order of 320 C or less, which makes it compatible with current parabolic trough collector systems. A system model which lends itself to optimization studies was constructed and exercised over a range of the multiparameter space involved. The collector field, storage, supplementary fossil boiler and superheater, and turbine/generator traded off to obtain a series of economically optimal systems for various years and solar fractions. DOE

N82-16511# Lincoln Lab., Mass. Inst. of Tech., Lexington.
REDUCING CONVECTIVE LOSSES FROM COVER GLAZINGS OF SOLAR-THERMAL COLLECTORS
Pattabiraman Raghuraman and Daniel Kon 1981 8 p refs Presented at the Winter Ann. Meeting of the ASME Technol. and Soc. Div., Washington, D.C., 15-20 Nov. 1981
(Contract DE-AC02-76ET-20279)
(DE81-025726; DOE/ET-20279/146; CONF-811101-9) Avail: NTIS HC A02/MF A01

Convective heat losses from cover glazings of solar thermal collectors are reduced by forming perpendicular criscross rectangular grooves on the glazing which cause the air flow to form recirculating zones in the grooves. Experiments on the effects of varying groove geometry show that the cover-glazing convective heat transfer coefficient can be reduced by a factor of four or better. Results of the experimental and analytical work and a description of the design considerations in optimizing the groove geometry are presented. DOE

N82-16518# Brookhaven National Lab., Upton, N. Y. Technology and Data Div.
MODELING SOLAR-ENERGY SYSTEMS FOR ECONOMIC OPTIMIZATION
Richard W. Leigh 1981 6 p refs Presented at the 4th World Eng. Congr., Atlanta, 12 Oct. 1981
(Contract DE-AC02-76CH-00016)
(DE81-030030; BNL-29963; CONF-811030-2) Avail: NTIS HC A02/MF A01

A simple analytic model of solar energy systems is presented which can describe how the performance of the system depends on collector area and storage capacity with surprising accuracy. The model can then be used to determine easily the optimal (lower cost) configuration of collector area and storage capacity, and to see how this configuration will change under various possible fuel, collector, or storage costs. DOE

N82-16627# Battelle Pacific Northwest Labs., Richland, Wash.
DEVELOPMENT OF A LOW-COST BLACK-LIQUID SOLAR COLLECTOR, PHASE 2 Final Report, Sep. 1979 - Jul. 1981
D. K. Landstrom, S. G. Talbert, and V. D. McGinniss 30 Sep. 1981 225 p refs
(Contract DE-AC04-79CS-30171)
(DE82-000033; DOE/CS-30171/3) Avail: NTIS HC A10/MF A01

Research efforts were directed toward: evaluating the long-term durability of various plastic materials and solar collector designs; obtaining sufficient outdoor performance data to design a full-scale demonstration of a black liquid solar collector for a commercial application; working closely with a company willing to investigate the possible commercialization of a black liquid plastic collector; and incorporating improved black liquides with the identified plastic collector designs. Indoor weathering tests of various plastics have continued and two outdoor automated test facilities were constructed. One unit was installed at Columbus, Ohio, and the other unit was installed in Phoenix, Arizona. In addition, test facilities in Florida were utilized for static outdoor testing of candidate materials. Results indicate that the black liquid collector is a viable concept and the collectors manufactured during the course of this study were able to perform as theoretically predicted. There are some long-term durability problems still associated with the black liquid collector systems. However, current indications are that a suitable system can be built that should have an expected lifetime of up to 15 years with only marginal (less than 10%) performance degradation. DOE

N82-16528# Argonne National Lab., Ill.
DESIGN, CONSTRUCTION, AND INITIAL OPERATION OF THE ANL RESEARCH
Y. S. Cha, W. T. Sha, and J. R. Hull Aug. 1981 50 p refs
(Contract W-31-109-eng-38)
(DE82-001961; ANL-81-55) Avail: NTIS HC A03/MF A01

The design consideration of a 1/4 acre research salt-gradient solar pond is described. Experience learned during the construction of the solar pond is presented. Initial operation of the pond indicates that the construction of the pond is sound and no leakage has occurred. The pond began to warm up during March of 1981. The maximum pond temperature reached 830 C at the end of July and it is still rising. All signs indicate that the operation of the well instrumented pond will be a success and the performance of the pond will be as expected, if not better. DOE

N82-16531# Winter (Steven) Associates, Inc., New York, N.Y.
CODE WORKBOOK FOR ACTIVE AND PASSIVE SOLAR DESIGN: SINGLE-FAMILY RESIDENTIAL CONSTRUCTION
Sep. 1981 109 p refs
(DE82-000637; MASEC-SCR-81-085) Avail: NTIS HC A06/MF A01

Important codes and standards enforced or referenced in the Mid-American Solar Energy Complex region are described. Analyses of the basic codes written by major code agencies and those Federal agency guidelines which have a significant impact on building activity in the MASEC region are included. State and local codes and code agencies are identified. DOE

N82-16532# Mid-American Solar Energy Complex, Minneapolis, Minn.
CASE STUDIES OF RETROFIT APPLICATIONS OF SOLAR ENERGY IN THE MASEC REGION
Sep. 1981 11 p refs
(Contract DE-AC02-79CS-30150)
(DE82-001712; MASEC-R-81-081; A-101-8) Avail: NTIS HC A02/MF A01

Six case studies are presented of residential solar retrofits. Each case study includes a photograph illustrating the type of retrofit, system description, siting orientation, system cost, energy savings, operational problems, and the homeowner's assessment of system performance and satisfaction. The retrofits presented cover a wide geographic area, and include active solar domestic hot water, greenhouses, and passive solar direct gain. DOE

N82-16533# Mid-American Solar Energy Complex, Minneapolis, Minn.
THE CLASS C PASSIVE PERFORMANCE EVALUATION PROGRAM Final Report
Sep. 1981 24 p
(Contract DE-AC02-79CS-30150)
(DE82-000454; MASEC-R-81-014; P-101-2) Avail: NTIS HC A02/MF A01

The Class-C performance which provides information on qualities of passive solar features which make them attractive to buyers was evaluated. The following topics are discussed: design of an audit form; design of regionally specific audit addenda; determination of site selection criteria; identification of sites; selection, training, and management of auditors; and packaging of materials of subcontractors for evaluation. Results and findings are presented as follows: demographic profile, passive solar home profile, cost, financing, and payback considerations, expectations, realizations, and satisfaction, and decisionmaking. DOE

N82-16538# Northeast Solar Energy Center, Boston, Mass. Dept. of Consumer Affairs.
SOLAR CONSUMER ASSURANCE: AN ASSESSMENT OF MECHANISMS IN THE NORTHEAST
Roberta Ward Walsh May 1981 88 p
(Contract DE-AC02-80CS-30149)
(DE81-030052; NESEC-9) Avail: NTIS HC A05/MF A01

Results and analysis of assessments in the nine states served by the Northeast Solar Energy Center are reported. Mechanisms were categorized according to the following objectives the informal

consumer, the competent installer, assuring product quality and performance, and responsiveness to consumer grievances. DOE

N82-16540# Mid-American Solar Energy Complex, Minneapolis, Minn.
PASSIVE SOLAR PRODUCTS CATALOG, 1981
M. M. Dotseth 1981 362 p
(Contract DE-AC02-79CS-30150)
(DE82-000292; MASEC-H-81-041) Avail: NTIS HC A16/MF A01

The Passive Solar Products Catalog was compiled through contacts with over 500 manufacturers and distributors across the country. The product listings are from manufacturers who responded to requests for information and the descriptions are based on information contained in the product literature. Only those products which can be marketed at this time are listed in the 1981 catalog. The catalog contains over 300 product listings. The catalog is organized according to product function and application including passive solar components and design resonances and miscellaneous products. Manufacturer and product indexes are included as a cross reference in the back of the catalog. Distributors are not listed since most manufacturers prefer to have product inquiries initially directed to them. DOE

N82-16542# Houston Univ., Tex. Energy Lab.
SOLAR ENERGY SYSTEMS SIMULATION AND ANALYSIS Quarterly Progress Report, 1 Nov. - 30 Dec. 1980
Loren L. Vant-Hull 10 Jan. 1981 36 p refs
(Contract DE-AC03-76SF-10763)
(DE81-026975; DOE/SF-10763/T10; QPR-5) Avail: NTIS HC A03/MF A01

A subroutine to provide central receiver performance simulation code STEAEC with the capability of interpolating the UofH NS code performance summary has been written and is documented herein. A call of this subroutine obviates the need to extrapolate day/hour output efficiencies to produce the elevation-azimuth field performance data, which often involves non-physical Sun locations. The changes are completely transparent to the user. The aspect ratio study was delayed while substantive improvements to the handling of heliostate spacing subject to mechanical limits were made. Mechanical limits play a definitive roll as the aspect ratio increases. The improvements are described. Work on insolation modeling is being culminated with the development of a new procedure for accounting for atmospheric transmission losses between heliostat and receiver. A detailed interpolation/extrapolation procedure based on the LOWTRAN 3 analysis was developed. Subroutines to provide all the necessary input data were also generated. Work has begun on a tentative basis which will lead to a user compatible version of the IH code and to an accompanying users guide. DOE

N82-16543# RCA Labs., Princeton, N. J.
PHOTOVOLTAIC MECHANISMS IN POLYCRYSTALLINE THIN-FILM SILICON SOLAR CELLS Final Report, 31 May 1979 - 30 May 1981
D. Redfield Jun. 1981 79 p refs
(Contract DE-AC01-79ET-23108)
(DE82-000868; DOE/ET-23108/8) Avail: NTIS HC A05/MF A01

The emphasis during this two-year program began with analysis of fundamental limitations to silicon solar-cell efficiency caused by heavy-doping effects. Near the middle, the emphasis shifted to explanation of the varied electronic properties of grain boundaries in Si. In the first area, and it was shown that all previous analyses which had neglected Auger recombination were necessarily invalid. Important consequences were also found for the strong gradients in dopant concentration that always occur in heavily doped diffused p-n junctions. When these new effects are combined, a simple, natural model results to explain limitations in Si solar-cell performance due to either front or base region effects on either J/sub sc/ or V/sub oc/. As part of this work, a new method was developed for accurate evaluation of the overall performance of AR coatings. DOE

N82-16544# National Mechanical Engineering Research Inst., Pretoria (South Africa).
DEVELOPMENTS IN SOLAR-POWERED AIR CONDITIONING: STATE-OF-THE-ART AND PROSPECTS FOR SOUTH AFRICA
A. Johannsen 1980 19 p refs Presented at Frigair Symp., Pretoria, 17-18 Jun. 1980, sponsored by the South African Inst. of Refrigeration and Air Conditioning
(PB81-246076; CSIR-ME-436; Paper-10) Avail: NTIS HC A02/MF A01 CSCL 13A

The state of the art of solar powered air conditioning is reviewed and its potential for South African conditions examined. Three basic cycles, namely the absorption cycle, the Rankine cycle, and desiccant cycle are discussed and their advantages and disadvantages compared. The open cycle type desiccant systems which appear to be well suited for South African conditions are discussed in greater detail. Included is a review of the various system configurations with solid and liquid desiccant and a comparison of their performance under different climatic conditions. Author

N82-16929# Mid-American Solar Energy Complex, Minneapolis, Minn.
REGIONAL NEEDS REGARDING TECHNICAL INFORMATION
Jul. 1981 16 p refs
(Contract DE-AC02-79CS-30150)
(DE82-001772; MASEC-R-81-057; A-104-4) Avail: NTIS HC A02/MF A01

Regional needs for technical information regarding solar systems and components are evaluated. The information requested from the MASEC Information Center can be separated into design, performance, and economic categories. The types of questions most frequently asked in each of these categories are listed. Comments by MASEC on the draft of the National Solar Data Network (NSDN) program are presented in the appendix. DOE

N82-17609*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.
SATELLITE POWER SYSTEM. CONCEPT DEVELOPMENT AND EVALUATION PROGRAM, VOLUME 6: CONSTRUCTION AND OPERATIONS
Harold Benson and Lyle M. Jenkins Apr. 1981 216 p refs
(NASA-TM-58233; JSC-17220-Vol-6) Avail: NTIS HC A10/MF A01 CSCL 10A

The construction, operation, and maintenance requirements for a solar power satellite, including the space and ground systems, are reviewed. The basic construction guidelines are explained, and construction location options are discussed. The space construction tasks, equipment, and base configurations are discussed together with the operations required to place a solar power satellite in geosynchronous orbit. A rectenna construction technique is explained, and operation with the grid is defined. Maintenance requirements are summarized for the entire system. Key technology issues required for solar power satellite construction operations are defined. E.A.K.

N82-17610*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RESULTS OF THE 1981 NASA/JPL BALLOON FLIGHT SOLAR CELL CALIBRATION PROGRAM
C. H. Seaman and R. S. Weiss 15 Jan. 1982 16 p refs
(Contract NAS7-100)
(NASA-CR-168442; JPL-Pub-81-115) Avail: NTIS HC A02/MF A01 CSCL 10A

The calibration of the direct conversion of solar energy through use of solar cells at high altitudes by balloon flight is reported. Twenty seven modules were carried to an altitude of 35.4 kilometers. Silicon cells are stable for long periods of time and can be used as standards. It is demonstrated that the cell mounting cavity may be either black or white with equal validity in setting solar simulators. The calibrated cells can be used as reference standards in simulator testing of cells and arrays. E.A.K.

N82-17611*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SENSITIVITY ANALYSIS OF THE ADD-ON PRICE ESTIMATE FOR THE SILICON WEB GROWTH PROCESS
Anant R. Mokashi 15 Dec. 1981 37 p refs
(Contracts NAS7-100; DE-AI01-76ET-20356; JPL Proj 5101-175)
(NASA-CR-168422; JPL-5101-175; DOE/JPL-1012-81) Avail: NTIS HC A03/MF A01 CSCL 10A

The web growth process, a silicon-sheet technology option, developed for the flat plate solar array (FSA) project, was

examined. Base case data for the technical and cost parameters for the technical and commercial readiness phase of the FSA project are projected. The process add on price, using the base case data for cost parameters such as equipment, space, direct labor, materials and utilities, and the production parameters such as growth rate and run length, using a computer program developed specifically to do the sensitivity analysis with improved price estimation are analyzed. Silicon price, sheet thickness and cell efficiency are also discussed. E.A.K.

N82-17614*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE 18TH PROJECT INTEGRATION MEETING Progress Report, Feb. - Jul. 1981
Jul. 1981 577 p refs Meeting held at Pasadena, Calif., 15-16 Jul. 1981
(Contract NAS7-100; DE-AI01-76ET-20356)
(NASA-CR-168431; JPL-Pub-81-94; JPL-5101-186) Avail. NTIS HC A25/MF A01 CSCL 10A

Progress in the low cost solar array project during the period February to July 1981 is reported. Included are: (1) project analysis and integration; (2) technology development in silicon material, large area silicon sheet and encapsulation; (3) process development; (4) engineering, and operations. E.A.K.

N82-17628# Jydsk Telefon A/S Biblioteket, Aarhus-Tranbjerg J. (Denmark).
SOLAR-CELL PROJECT Progress Report
B. Mortensen and Johs Jansen (Odense Univ.) Aug. 1980 42 p refs In DANISH
(DE82-901191; NP-2901191; PR-1) Avail: NTIS (US Sales Only) HC A03/MF A01; DOE Depository Libraries

Commercially available solar cells and battery systems were tested. The details of the experimental solar cell/battery array placed on the roof of the Jutland Telephone telestation near Aarhus, Denmark are described. A survey of module calculations and meteorological data in this region is given. The systems tested, their components, solar cell arrays and mechanical and electrical equipment are described and measuring methods and data processing are outlined. DOE

N82-17632# Seymour Community Schools, Wis.
COMMUNITY SOLAR DEMONSTRATION/DISSEMINATION CENTER Final Report
Richard Tepp 8 Jul. 1981 14 p
(Contract DE-FG02-80R5-10250)
(DE82-000994; DOE/R5-10250/T1) Avail: NTIS HC A02/MF A01

A passive/active solar heating demonstration component was constructed. A greenhouse was installed, and the active system was completed. The fireplace was also completed. A direct gain 8 by 20 double glazed greenhouse system on concrete footings and masonary blocks was incorporated. The greenhouse includes a 4 in. concrete slab with 2 in. of thermal below grade insulation. Other key elements include a 30 in. hinged entrance door, screens and motor-operated louver vents for summer ventilation. Manual operated dampers are built into the trombe wall, which was constructed as the backdrop of the greenhouse. DOE

N82-17633# Texas Instruments, Inc., Dallas.
DEVELOPMENT OF A SOLAR-ENERGY SYSTEM Technical Summary Report
E. L. Johnson 3 Apr. 1981 23 p
(Contract DE-AC01-79ER-10000)
(DE81-030531; DOE/ER-10000/T2) Avail: NTIS HC A02/MF A01

Solar energy conversion by operation of small silicon solar cells immersed in an electrolyte is described. The current generated by the cells is used to separate the electrolyte into its constituent parts. The system consists of a solar chemical converter in which the electrolyte is separated, hydrogen storage, a fuel cell, and a heat exchanger for recovering heat from the system. Fabrication of the solar cells used in the solar chemical convertor and the storage of hydrogen as a metal hydride are discussed. DOE

N82-17644# World Meteorological Organization, Geneva (Switzerland).
METEOROLOGICAL ASPECTS OF THE UTILIZATION OF SOLAR RADIATION AS AN ENERGY SOURCE, PART 1
1981 311 p refs 2 Vol.
(WMO-557-Vol-1; WMO-TN-172-Vol-1; ISBN-92-63-10557-X) Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 50

Meteorological knowledge and activities related to the harnessing of solar energy are treated. The development of the utilization of various forms of energy by human society is reviewed along with WMO activities in support of the rational use of energy, with special regard to solar radiation. Specific actions by which meteorological services can contribute to the utilization of solar energy are pointed out. User requirements for meteorological data are set; how the data is presented and where it can be obtained are shown. Techniques for the measurement of solar radiation, including the calibration of instruments and quality control of data, are discussed while other meteorological parameters required (air temperature, wind speed, humidity, cloud amount, etc.) are also considered. The retrieval of past data, interpolation methods for the estimation of solar radiation, and publishing and archiving data are dealt with. Author (ESA)

N82-17645# World Meteorological Organization, Geneva (Switzerland).
METEOROLOGICAL ASPECTS OF THE UTILIZATION OF SOLAR RADIATION AS AN ENERGY SOURCE. PART 2: ANNEX, WORLD MAPS OF RELATIVE GLOBAL RADIATION
1981 33 p refs 2 Vol.
(WMO-557-Vol-2; WMO-TN-172-Vol-2) Avail: NTIS MF A01; print copy available at WMO, Geneva, SwFr 50

World maps are presented from which the monthly and annual global radiation can be derived, and an overall picture of the distribution of solar radiation as an energy source can be evolved. The radiation reaching the surface of the Earth in the absence of clouds and the atmosphere was calculated from pure astronomical relationships. Results are given in MJ/sq m by 5 deg of latitude. The establishment of an empirical relationship between satellite brightness data and the relative global radiation (defined as the percentage ratio of actual surface global radiation to the astronomically possible global radiation), using available surface global radiation data as reference values, is suggested. Author (ESA)

N82-17647# Office of Technology Assessment, Washington, D. C.
SOLAR POWER SATELLITES
Aug. 1981 300 p refs
(PB82-108846; OTA-E-144; LC-81-600129) Avail: NTIS HC A13/MF A01 CSCL 10B

The energy potential of the solar power satellite (SPS) was evaluated. The preliminary nature of SPS technology is considered by comparing four alternative SPS systems across a broad range of issues: their technical characteristics, long term energy supply potential, international and military implications, environmental impacts, and institutional effects. The SPS options are also compared to potentially competitive future energy technologies. GRA

N82-18437# National Bureau of Standards, Boulder, Colo. National Engineering Lab.
PRELIMINARY GUIDELINES FOR CONDITION ASSESSMENT OF BUILDINGS BEING CONSIDERED FOR SOLAR RETROFIT
Frank H. Lerchen, James H. Pielert, and Phillip T. Chen Jul. 1981 142 p refs Sponsored by DOE
(PB82-113259; NBSIR-81-2289) Avail: NTIS HC A07/MF A01 CSCL 13A

A general description of methods currently available for condition assessment of the structural heating, ventilating, and air conditioning (HVAC); electrical and plumbing systems of an existing building are reported. The feasibility of rehabilitation for solar retrofit is determined. GRA

N82-18529# Centro Informazioni Studi Esperienze, Milan (Italy). Servizio Documentazione.
HIGH CONCENTRATION IN GaAs PHOTOVOLTAIC SYSTEMS [L'ALTA CONCENTRAZIONE NEI SISTEMI FOTOVOLTAICI AL GaAs]
G. Guarini 1981 12 p refs In ITALIAN Presented at Giornate di Studio su Conversione Fotovoltaica dell'Energia Solare, Milan, 4-5 Jun. 1981
(CISE-1713) Avail: NTIS HC A02/MF A01

The feasibility of a spectral separation method for increasing the efficiency of photovoltaic cells is considered. The technical state of the art of GaAs cells is reviewed. The structure of a 100 Wp high concentration system, comprised of a matrix of Fresnel lenses with as many spectral filters and pairs of cells is described. Operating results are analyzed. Transl. by J.D.H.

N82-18581*# Schafer (W. J.) Associates, Inc., Arlington, Va.
INVESTIGATION OF POSSIBILITIES FOR SOLAR-POWERED HIGH-ENERGY LASERS IN SPACE
In NASA. Langley Research Center Space Laser Power Transmission System Studies Feb. 1982 p 45-56

Avail: NTIS HC A10/MF A01 CSCL 20E

Solar pumped lasers were investigated. The literature was reviewed for possible solar laser candidates from optical pumping experiments. A baseline CO electric discharge laser system was shown to be technically feasible. The most promising direct solar pumped laser was identified to be CF3I. Using the 'STAG' solar laser concept and CF3I, it was found that such a system could be weight competitive with the baseline CO laser system. N.W.

N82-18582*# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
DESIGN INVESTIGATION OF SOLAR-POWERED LASERS FOR SPACE APPLICATIONS
In NASA. Langley Research Center Space Laser Power Transmission System Studies Feb. 1982 p 77-84

Avail: NTIS HC A10/MF A01 CSCL 20E

The feasibility of using solar powered continuous wave (CW) lasers for space power transmission was investigated. Competing conceptual designs are considered. Optical pumping is summarized. Solar pumped Lasant type lasers are outlined. Indirect solar pumped lasers are considered. N.W.

N82-18686* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR ENERGY CONTROL SYSTEM Patent
James R. Currie, inventor (to NASA) Issued 8 Dec. 1981 9 p Filed 20 Nov. 1979 Supersedes N80-17544 (18 - 08, p 1023)
(NASA-Case-MFS-25287-1; US-Patent-4,304,219; US-Patent-Appl-SN-096570; US-Patent-Class-126-422; US-Patent-Class-126-429; US-Patent-Class-126-430) Avail: US Patent and Trademark Office CSCL 10A

A solar energy control system for a hot air type solar energy heating system wherein thermocouples are arranged to sense the temperature of a solar collector, a space to be heated, and a top and bottom of a heat storage unit is disclosed. Pertinent thermocouples are differentially connected together, and these are employed to effect the operation of dampers, a fan, and an auxiliary heat source. In accomplishing this, the differential outputs from the thermocouples are amplified by a single amplifier by multiplexing techniques. Additionally, the amplifier is corrected as to offset by including as one multiplex channel a common reference signal.
Official Gazette of the U.S. Patent and Trademark Office

N82-18688*# Applied Solar Energy Corp., City of Industry, Calif.
DEVELOPMENT OF THIN WRAPAROUND JUNCTION SILICON SOLAR CELLS Final Report, Sep. 1980 - Nov. 1981
F. Ho and P. A. Iles Nov. 1981 43 p refs
(Contract NAS3-22228)
(NASA-CR-165570) Avail: NTIS HC A03/MF A01 CSCL 10A

The state of the art technologies was applied to fabricate 50 micro thick 2x4 cm, coplanar back contact (CBC) solar cells with AMO efficiency above 12%. A requirement was that the cells have low solar absorptance. A wraparound junction (WAJ) with wraparound metallization was chosen. This WAJ approach avoided the need for very complex fixturing, especially during rotation of the cells for providing adequate contacts over dielectric edge layers. The contact adhesion to silicon was considered better than to an insulator. It is indicated that shunt resistance caused by poor WAJ diode quality, and series resistance from the WAJ contact give good cell performance. The cells developed reached 14 percent AMO efficiency (at 25 C), with solar absorptance values of 0.73. Space/cell environmental tests were performed on these cells and the thin CSC cells performed well. The optimized design configuration and process sequence were used to make 50 deliverable CBC cells. These cells were all above 12 percent efficiency and had an average efficiency of 13 percent. Results of environmental tests (humidity-temperature, thermal shock, and contact adherence) are also given. E.A.K.

N82-18695*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THERMODYNAMIC LIMITS FOR SOLAR ENERGY CONVERSION BY A QUANTUM-THERMAL HYBRID SYSTEM
C. E. Byvik, A. M. Buoncristiani, and B. T. Smith Nov. 1981 20 p refs Prepared in cooperation with Christopher Newport Coll.
(NASA-TM-83229) Avail: NTIS HC A02/MF A01 CSCL 10A

The limits are presented to air mass 1.5 conditions. A maximum conversion efficiency of 74 percent is thermodynamically achievable for the quantum device operating at 3500 K and the heat engine in contact with a reservoir at 0 K. The efficiency drops to 58 percent for a cold reservoir at approximately room temperature conditions. Hybrid system efficiencies exceed 50 percent over receiver temperatures ranging from 1400 K to 4000 K, suggesting little benefit is gained in operating the system above 1400 K. The results are applied to a system consisting of a photovoltaic solar cell in series with a heat engine. T.M.

N82-18696*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE ULTIMATE EFFICIENCY OF PHOTOSENSITIVE SYSTEMS
A. M. Buoncristiani, C. E. Byvik, and B. T. Smith Dec. 1981 22 p refs Prepared in cooperation with Christopher Newport Coll.
(Grant NsG-1514)
(NASA-TM-83230) Avail: NTIS HC A02/MF A01 CSCL 10A

These systems have in common two important but not independent features: they can produce a storable fuel, and they are sensitive only to radiant energy with a characteristic absorption spectrum. General analyses of the conversion efficiencies were made using the operational characteristics of each particular system. An efficiency analysis of a generalized system consisting of a blackbody source, a radiant energy converter having a threshold energy and operating temperature, and a reservoir is reported. This analysis is based upon the first and second laws of thermodynamics, and leads to a determination of the limiting or ultimate efficiency for an energy conversion system having a characteristic threshold. T.M.

N82-18697*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THERMODYNAMIC LIMITS TO THE EFFICIENCY OF SOLAR ENERGY CONVERSION BY QUANTUM DEVICES
A. M. Buoncristiani, C. E. Byvik, and B. T. Smith (Christopher Newport College, Va.) Nov. 1981 14 p refs
(NASA-TM-83228) Avail: NTIS HC A02/MF A01 CSCL 10A

The second law of thermodynamics imposes a strict limitation to the energy converted from direct solar radiation to useful work by a quantum device. This limitation requires that the amount of energy converted to useful work (energy in any form other than heat) can be no greater than the change in free energy of the radiation fields. Futhermore, in any real energy conversion device, not all of this available free energy in the radiation field can be converted to work because of basic limitations inherent in the device itself. A thermodynamic analysis of solar energy conversion by a completely general prototypical quantum device is presented. This device is completely described by two parameters, its operating temperature T sub R and the energy threshold of its absorption spectrum. An expression for the maximum thermodynamic efficiency of a quantum solar converter was derived in terms of these two parameters and the incident radiation spectrum. Efficiency curves for assumed solar spectral irradiance corresponding to air mass zero and air mass 1.5 are presented. T.M.

N82-18698*# DHR, Inc., Washington, D.C.
MARKET ASSESSMENT OF PHOTOVOLTAIC POWER

SYSTEMS FOR AGRICULTURAL APPLICATIONS IN NIGERIA Final Report
David Staples, Henry Steingrass, and James Nolfi (ARD, Inc., Burlington, Vt.) Oct. 1981 115 p refs
(Contracts DEN3-180; DE-AI01-79ET-20485)
(NASA-CR-165511; DOE/NASA/0180-4; C4100-50) Avail: NTIS HC A06/MF A01 CSCL 10A

The market potential for stand-alone photovoltaic systems in agriculture was studied. Information is presented on technical and economically feasible applications, and assessments of the business, government and financial climate for photovoltaic sales. It is concluded that the market for stand-alone systems will be large because of the availability of captial and the high premium placed on high reliability, low maintence power systems. Various specific applications are described, mostly related to agriculture. R.J.F.

N82-18699# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
I-V CHARACTERIZATION OF SOLAR CELLS [CARACTERIZACAO I-V DE CELULAS SOLARES]
Nelson Veissid, R. Ranvaud, and F. J. Fonseca Jun 1981 12 p refs In PORTUGUESE; ENGLISH summary Presented at the 33rd Ann. Meeting of SBPC, Salvador, Brazil, 8-15 Jul. 1981 Submitted for publication
(INPE-2141-RPE/363) Avail: NTIS HC A02/MF A01

Equivalent circuits were analysed and then I-V characteristics obtained from different solar cells were compared with those from the circuits. The measures were obtained under natural conditions and under artificial conditions (solar simulator made of easily obtained light sources and several filters). The identification of components in the equivalent circuit, together with the theory of photovoltaic conversion, is very important in the optimization of the cell design. A numeric method for determination of the series resistance is proposed. T.M.

N82-18702# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Lab.
CONCEPTUAL DESIGN OF A SOLAR COGENERATION FACILITY INDUSTRIAL PROCESS HEAT. VOLUME 2: APPENDICES Final Report, 30 Sep. 1980 - 14 Aug. 1981
Patrick Joy, Martin Brzeczek, Harold Seilestad, Carl Silverman, and George Yenetchi Jul. 1981 412 p Prepared in cooperation with Badger Energy, Inc., Cambridge, Mass., and Martin Marietta Aerospace, Denver, Colo., and Pacific Gas and Electric Co., San Ramon, Calif.
(Contract DE-AC03-80SF-11438)
(DE82-001578; DOE/SF-11438/T1-Vol-2) Avail: NTIS HC A18/MF A01

The cogeneration facility systems specification defines the characteristics, and design and environmental requirements for the facility and the performance, characteristics and economic data for the solar additions as well as design data for the existing facility. Climatological data are presented for the site. GRA

N82-18703# Nebraska Univ., Lincoln.
MONITORING OF THERMAL STRATIFICATION OF THE STORAGE TANK OF THE MABEL LEE HALL SOLAR-HOT-WATER FACILITY Final Technical Report, 15 Oct. 1979 - 30 Nov. 1980
E. E. Anderson May 1981 37 p refs
(Contract DE-AC02-79CS-30247)
(DE82-002110; DOE/CS-30247/1) Avail: NTIS HC A03/MF A01

Measurements of temperatures and heat inputs for a large liquid solar storage unit were obtained with sufficient spatial and temporal resolution to permit verification of numerical models. Fourteen tests were conducted on the Mabel Lee Hall solar facility. During each two-day test, forty temperatures and three heat inputs were measured every 15 minutes. All the data were reported to DOE and are available for confirmation of numerical models of liquid solar storage units. Examination of the results of five of the tests including charging, discharging and simultaneous charge-discharge operational modes indicate that stratification was maintaind in the tank. The data also show that several natural circulation modes develop depending upon the manner in which the system was operated. DOE

N82-18713# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
A 100 kWe SOLAR THERMAL POWER PLANT IN KUWAIT, PHASE 1 Final Report, Jun. 1980
Guenther Schmidt, Peter Schmid, Dietmar Wolf, and Helmut Zewen Bonn Bundesministerium fuer Forschung und Technology Oct. 1981 47 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology
(BMFT-FB-T-81-178; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10.10

The assembly and test program of the main system components of the solar thermal power station are described. The installation is of the solar farm type and uses highly concentrating rotational symmetric paraboloid mirrors to achieve high efficiencies and Rankine cycle operating temperatures as high as 350 C. The working medium is toluene. Performance tests show proper functioning of the tracking system of the collectors, of the coneshaped absorbers and of the energy conversion system, including all control loops. Author (ESA)

N82-18714# Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany).
CONSTRUCTION AND TESTING OF A TEST STAND FOR SOLAR CELLS AND CONCENTRATING COLLECTORS Final Report, Apr. 1980
Hainz Pfeiffer Bonn Bundesministerium fuer Forschung und Technology Nov. 1981 131 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology
(BMFT-FB-T-81-179; ISSN-0340-7608) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 27.70

A hibrid system consisting of photovoltaic cells and parabolic concentrators was built and tested in order to study the possible cost reduction of photovoltaic systems by concentration of sunlight. The test stand comprises four parabolic tracking reflectors, a cooling circuit, electrical and thermodynamical instrumentation and an electrical water pump as a load. The solar cells are mounted in the focal line of the collectors on a cooling channel designed for optimal heat transfer and their uniform illumination is carefully adjusted. The photovoltaic generator delivers electrical energy with 9.3% efficiency at 25 C. In the hybrid regime the thermal efficiency attains 45% at a temperature of 90 C, and the electrical efficiency 6%. Author (ESA)

N82-18715# Metallgesellschaft, A.G., Frankfurt am Main (West Germany).
DEVELOPMENT OF SELECTIVE SOLAR ABSORBERS ON THE BASIS OF ALUMINUM ROLL-BOND HEAT EXCHANGERS Final Report, Jun. 1980
Manfred Moeller Bonn Bundesministerium fuer Forschung und Technology Nov. 1981 44 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology
(BMFT-FB-T-81-183; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9.25

A deposition technique comparable to two-stage anodizing and especially suited for solar absorber panels, using roll-bond Al 99.5 and AlMnZr alloys as a substrate, was developed. The coating is of the nickel structure filter type and provides average solar absorptivity values of 94% and thermal emission values of 14%. The setup of a production plant capable of coating surfaces up to 2 sq m is described as well as the development of corrosion resistent hermetically sealed collectors. By means of an appropriate surface treatment the same corrosion resistance was achieved for absorbers mounted in ventilated collectors. Author (ESA)

N82-18716# Metallgesellschaft, A.G., Frankfurt am Main (West Germany). Metall-Lab
AIRTIGHT COLLECTOR CASINGS Final Report
Manfred Moeller Bonn Bundesministerium fuer Forschung und Technology Oct. 1981 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology
(BMFT-FB-T-81-184; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15.20

The gas space between absorber and cover plates is hermetically sealed by means of a permanent elastic seal of the

polysulfide or polyisobutylene type. The absorber-glass bond fits into a special frame to be manufactured and mounted industrially for easy assembly with titanium-zinc roof structures. The latter is made of prefabricated parts that can easily be joined by soldering. Adequate protection against penetration of rain, water, snow, and dust is provided for. The flat roof mounting is so designed that no boring through the cover is needed for fixing. Test results show high efficiency and long service life.
Author (ESA)

N82-18717# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DEVELOPMENT OF SELECTIVE SOLAR ABSORBERS ON THE BASIS OF ALUMINUM ROLL-BOND HEAT EXCHANGERS Final Report, Dec. 1979
Werner Scherber and Bernhard Schroeder. Bonn. Bundesministerium fuer Forschung und Technology. Oct. 1981. 105 p. refs. In GERMAN; ENGLISH summary. Sponsored by Bundesministerium fuer Forschung und Technology
(BMFT-FB-T-81-186; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 22.30

A deposition technique for selective coatings akin to two-stage anodizing and especially suited for aluminum solar absorber panels was developed. The coating consists of tiny, velvet-like arranged nickel whiskers and provides a solar absorptivity as high as 94% and a low thermal emissivity of 12% to 17%. The coating technique, the production setup, and the test program are described. The coating proves to be resistent to humidity cycle testing and may be used in ordinary ventilated collectors. After production in a pilot production plant of about 10,000 roll-band panels with outstanding optical quality, homogeneity and long-term stability, a series production plant with a 7 m bath length was started. Author (ESA)

N82-18719# AEG-Telefunken, Wedel (West Germany). Fachbereich Neue Technologien, Raumfahrt.
DEVELOPMENT AND TESTS OF EXPERIMENTAL SOLAR GENERATORS FOR CONCENTRATING SYSTEMS Final Report, Mar. 1981
Hans Gochermann and Hubert Muehle. Bonn. Bundesministerium fuer Forschung und Technology. Oct. 1981. 34 p. refs. In GERMAN; ENGLISH summary. Sponsored by Bundesministerium fuer Forschung und Technology
(BMFT-FB-T-81-193; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 7.20

Terrestrial photovoltaic generators were developed for integration into a hybrid system designed to demonstrate cost reduction of photovoltaic systems by concentration of sunlight. The photovoltaic cells consist of monocrystalline silicon, n-p type, 5 by 5 sq cm large and 0.35 mm thick. The antireflection layer is made of TiOx and the contact system of passivated Ti(Pd)Ag. Usage of low ohmic materials and decrease of contact resistance by deeper n-diffusion allows for maintaining cell efficiency almost constant for intensities up to 0.2 W per sq cm. The layout of several hybrid systems using parabolic reflectors is given and the mounting of the solar cells is illustrated. Author (ESA)

N82-18722# National Mechanical Engineering Research Inst., Pretoria (South Africa). Heat Mechanics Div.
EXPERIMENTAL INVESTIGATION OF HEAT AND MASS TRANSFER RATES IN REGENERATING TYPE SOLAR COLLECTOR
A. Johannsen. Apr. 1981. 31 p. refs
(PB82-112244; CSIR-ME-1705; ISBN-00-7988-1475-6) Avail: NTIS HC A09/MF A01 CSCL 10A

Heat and mass transfer rates and air pressure drop in a regenerating type solar collector over the range of operating conditions expected in a real system were measured in a laboratory. The existence of analogy between heat and mass transfer in the collector was confirmed. GRA

N82-18725# Booz-Allen and Hamilton, Inc., Bethesda, Md.
EVALUATION OF RESIDENTIAL AND COMMERCIAL SOLAR/GAS HEATING AND COOLING TECHNOLOGIES. VOLUME 1: PROGRAM OVERVIEW Final Report, Dec. 1979 - Jan. 1981
Alan S. Hirshberg, Steven A. Haas, and Alan S. Jacobsen. Dec. 1980. 64 p. 2 Vol.
(Contract GRI-5014-345-0280)
(PB82-103847; GRI-79/0105.1) Avail: NTIS HC A04/MF A01 CSCL 13A

The technologies and economics of solar/gas systems for application in the single-family residential market and in the small (individual building) commercial market were evaluated. The effects of solar industry maturity on system cost and the impact of solar incentives and natural gas price uncertainties on solar/gas system economics were studied. Projected solar/gas systems with advanced conventional gas equipment such as pulse combustion furnaces are discussed. GRA

N82-18726# Booz-Allen and Hamilton, Inc., Bethesda, Md.
EVALUATION OF RESIDENTIAL AND COMMERCIAL SOLAR/GAS HEATING AND COOLING TECHNOLOGIES, VOLUME 2 Final Report, Dec. 1979 - Jan. 1981
Alan S. Hirshberg, Steven A. Haas, and Alan S. Jacobsen. Dec. 1980. 287 p. 2 Vol.
(Contract GRI-5014-345-0280)
(PB82-103854; GRI-79/0105.2) Avail: NTIS HC A13/MF A01 CSCL 13A

The economics of the most cost-effective solar/gas hybrid systems against a range of advanced gas-fired space conditioning equipment, including both conventional gas furnaces and pulse combustion gas furnaces were analyzed. In addition, the economic comparison considered improvements in performance and cost reduction for both solar/gas systems and advanced gas-fired equipment. GRA

N82-18729# National Bureau of Standards, Washington, D.C. Center for Building Technology.
FEDSOL: PROGRAM USER'S MANUAL AND ECONOMIC OPTIMIZATION GUIDE FOR SOLAR FEDERAL BUILDING PROJECTS Final Report
Jeanne W. Powell and Richard C. Rodgers, Jr. Aug. 1981. 113 p. refs. Prepared in cooperation with Rodgers (Richard C.), Jr., Sponsored in part by DOE
(PB82-107012; NBSIR-81-2342) Avail: NTIS HC A06/MF A01 CSCL 13A

A user's manual for the FEDSOL computer program is provided. The FEDSOL program determines the economically optimal size of a solar energy system for a user-specified building, location, system type, and set of economic conditions; it conducts numerous breakeven and sensitivity analyses; and it calculates measures of economic performance as required under the Federal Rules. The economic model in the program is linked with the SLR (solar load ratio) design method developed to predict the performance of active systems. The economics portion of the program can, however, be used apart from the SLR method, with performance data provided by the user. Author

N82-18764# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.
SOLAR ENERGY FOR POLLUTION CONTROL Final Report, 1 Jun. - 31 Oct. 1978
P. Overly and C. Frankling. Oct. 1981. 103 p. refs
(Contract EPA-68-03-2567; EPA Proj. 7396)
(PB82-116658; FR-80-39/EE; EPA-600/7-81-166) Avail: NTIS HC A06/MF A01 CSCL 13B

A study was conducted to determine which existing or emerging pollution control processes are best suited to make use of solar energy input and to determine the potential benefits of such applications. Pollution control processes were matched with compatible solar energy systems, resulting in the following four combinations: anaerobic digestion/flat-plate collector; anaerobic digestion/parabolic trough concentrator; baghouse heating/parabolic trough concentrator; SOX scrubbing/parabolic trough concentrator. GRA

N82-19669*# Arizona State Univ., Tempe.
SOCIOECONOMIC IMPACT OF PHOTOVOLTAIC POWER AT SCHUCHULI, ARIZONA Final Report
Donald Bahr, Billy G. Garrett, and Carolyn Chrisman. Oct. 1980. 181 p. refs
(Contracts DEN3-50; DE-AI01-79ET-20485)
(NASA-CR-165551; DOE/NASA/0050-1) Avail: NTIS HC A08/MF A01 CSCL 10A

The social and economic impact of photovoltaic power on a small, remote native American village is studied. Village history, group life, energy use in general, and the use of photovoltaic-

powered appliances are discussed. No significant impacts due to the photovoltaic power system were observed. R.J.F.

N82-19673*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATIONAL PERFORMANCE OF THE PHOTOVOLTAIC-POWERED GRAIN MILL AND WATER PUMP AT TANGAYE, UPPER VOLTA Summary Report, Mar. 1979 - Apr. 1981
James E. Martz, Anthony F. Ratajczak, and Richard DeLombard Feb. 1982 59 p refs Sponsored in part by Bureau for Development Support
(NASA-TM-82767; E-1089) Avail: NTIS HC A04/MF A01 CSCL 10B

The first two years of operation of a stand alone photovoltaic (PV) power system for the village of Tangaye, Upper Volta in West Africa are described. The purpose of the experiment was to demonstrate that PV systems could provide reliable electrical power for multiple use applications in remote areas where local technical expertise is limited. The 1.8 kW (peak) power system supplies 120-V (d.c.) electrical power to operate a grain mill, a water pump, and mill building lights for the village. The system was initially sized to pump a part of the village water requirements from an existing improved well, and to meet a portion of the village grain grinding requirements. The data, observations, experiences, and conclusions developed during the first two years of operation are discussed. Reports of tests of the mills used in the project are included. B.W.

N82-19676*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A REVIEW OF THE SALT-GRADIENT SOLAR POND TECHNOLOGY
E. I. H. Lin 30 Jan. 1982 60 p refs
(Contracts NAS7-100; DE-AI03-81SF-11552)
(NASA-CR-168635; JPL-Pub-81-116; JPL-5107-3; DOE/SF-11552/1) Avail: NTIS HC A04/MF A01 CSCL 10A

The state of the salt-gradient solar pond technology is reviewed. Highlights of findings and experiences from existing ponds to date are presented, and the behavior, energy yield, operational features, and economics of solar ponds are examined. It is concluded that salt-gradient solar ponds represent a technically feasible, environmentally benign, and economically attractive energy producing alternative. In order to bring this emerging technology to maturity, however, much research and development effort remains to be undertaken. Specific R&D areas requiring the attention and action of technical workers and decision-makers are discussed, both from the perspectives of smaller, thermally-oriented ponds and larger, electricity generating ponds. Author

N82-19677*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A LOW-POWER PHOTOVOLTAIC SYSTEM WITH ENERGY STORAGE FOR RADIO COMMUNICATIONS: DESCRIPTION AND DESIGN METHODOLOGY
C. P. Chapman, Paul D. Chapman (Everest and Jennings, Los Angeles), and Alvin H. Lewison (Simpson Electric Co., Elgin, Ill.) 15 Jan. 1982 73 p refs
(Contracts NAS7-100; DE-A101-76ET-20356)
(NASA-CR-168640; JPL-Pub-82-2) Avail: NTIS HC A04/MF A01 CSCL 10B

A low power photovoltaic system was constructed with approximately 500 amp hours of battery energy storage to provide power to an emergency amateur radio communications center. The system can power the communications center for about 72 hours of continuous nonsun operation. Complete construction details and a design methodology algorithm are given with abundant engineering data and adequate theory to allow similar systems to be constructed, scaled up or down, with minimum design effort. Author

N82-19683# New Mexico State Univ., Las Cruces.
DESIGN CALCULATION PROCEDURE FOR PASSIVE SOLAR HOUSES AT NAVY INSTALLATIONS IN REGIONS WITH COLD CLIMATE, VOLUME 1 Preliminary Report, Apr. 1980 - Sep. 1981
Monika Lumsdaine Port Hueneme, Calif. NCEL Oct. 1981 123 p refs 5 Vol.
(Contract N62583-79-MR-585)
(AD-A108382; CEL-CR-82.002-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 13/1

A 'worksheet' approach is used in that the user may work through an example passive solar design by following the text in the report. Included are tables for heating degree days, solar heat gains, building R factors, orientation factors, roof overhang designs, etc. Performance is calculated on a monthly basis. The reports are presented for five geographical regions with content and text format similar, differing only in the appropriate regional factors. This volume gives appropriate designs for Navy installations in regions with cold climate. GRA

N82-19685# New Mexico State Univ., Las Cruces.
DESIGN CALCULATION PROCEDURE FOR PASSIVE SOLAR HOUSES AT NAVY INSTALLATIONS IN REGIONS WITH WARM, HUMID CLIMATE, VOLUME 3 Preliminary Report, Apr. 1980 - Sep. 1981
Monika Lumsdaine Port Hueneme, Calif. NCEL Oct. 1981 132 p refs 5 Vol.
(Contract N62583-79-MR-585)
(AD-A108384; CEL-CR-82.004-Vol-3) Avail: NTIS HC A07/MF A01 CSCL 13/1

A 'worksheet' approach is used in that the user may work through an example passive solar design by following the text in the report. Included are tables for heating degree days, solar heat gains, building R factors, orientation factors, roof overhang designs, etc. Performance is calculated on a monthly basis. The reports are presented for five geographical regions with content and text format similar, differing only in the appropriate regional factors. This volume gives appropriate designs for Navy installations in regions with warm, humid climate. GRA

N82-19686# New Mexico State Univ., Las Cruces.
DESIGN CALCULATION PROCEDURE FOR PASSIVE SOLAR HOUSES AT NAVY INSTALLATIONS IN THE PACIFIC NORTHWEST, VOLUME 4 Preliminary Report, Apr. 1980 - Sep. 1981
Monika Lumsdaine Port Hueneme, Calif. NCEL Oct. 1981 120 p refs 5 Vol.
(Contract N62583-79-MR-585)
(AD-A108385; CEL-CR-82.005-Vol-4) Avail: NTIS HC A06/MF A01 CSCL 13/1

A 'worksheet' approach is used in that the user may work through an example passive solar design by following the text in the report. Included are tables for heating degree days, solar heat gains, building R factors, orientation factors, roof overhang designs, etc. Performance is calculated on a monthly basis. The reports are presented for five geographical regions with content and text format similar, differing only in the appropriate regional factors. This volume gives appropriate designs for Navy installations in the Pacific Northwest. GRA

N82-19687# New Mexico State Univ., Las Cruces.
DESIGN CALCULATION PROCEDURE FOR PASSIVE SOLAR HOUSES AT NAVY INSTALLATIONS IN WARM CALIFORNIA CLIMATES, VOLUME 5 Preliminary Report, Apr. 1980 - Sep. 1981
Monika Lumsdaine and Edward Lumsdaine Port Hueneme, Calif. NCEL Oct. 1981 121 p refs 5 Vol.
(Contract N62583-79-MR-585)
(AD-A108386; CEL-CR-82.006) Avail: NTIS HC A06/MF A01 CSCL 13/1

A 'worksheet' approach is used in that the user may work through an example passive solar design by following the text in the report. Included are tables for heating degree days, solar heat gains, building R factors, orientation factors, roof overhang designs, etc. Performance is calculated on a monthly basis. The reports are presented for five geographical regions with content and text format similar, differing only in the appropriate regional factors. This volume gives appropriate designs for Navy installations in warm California climates. GRA

N82-19688# Solarex Corp., Rockville, Md.
DESIGN OF MOBILE PHOTOVOLTAIC POWER SYSTEMS: 0.5-3kW Final Report
Roy D. Gibson 1 Oct. 1981 133 p
(Contract DAAK70-80-C-0147)
(AD-A108889) Avail: NTIS HC A07/MF A01 CSCL 10/2

This contract effort can be summarized by four technical tasks: Task 1 - Analysis of Engine-Generator Inventory and Use for a less than 5 kW system; Task 2 Parametric analysis of the Transportability of Photovoltaic System, i.e., the range of size

and weight of transportable trailers and the associated PV generator size; Task 3 - Preliminary Cost Estimates for Photovoltaic Systems; and Task 4 - Preliminary Photovoltaic System Design. This report presents the results of Task 1 for the engine generator set planned inventory and characteristics. Task 1 also contained candidate photovoltaic system configurations which would be compared with the engine-generator characteristics identified in Task 1. A parametric study was made of sizing trade-offs between photovoltaic arrays and battery storage capacities which were capable of at least meeting the identified engine-generator characteristics and on structural designs for the photovoltaic array and storage battery for the two trailer configurations. The preliminary cost estimate support in Task 3 involved life cycle cost analysis for the system sizes studied in Task 1. The Task 4 preliminary system design support consisted of examining the results of Tasks 1, 2 and 3 and determining characteristics of transportable photovoltaic systems. GRA

N82-19890# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Abteilung Energietechnik.
DEVELOPMENT OF SIMPLE SOLAR COLLECTORS Final Report
Wilmar Fuhse, Karl Jaeger, and Hans-Peter Kleinemeier. Bonn Bundesministerium fuer Forschung und Technologie Nov. 1981 314 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-174; ISSN-0340-7608) Avail: NTIS HC A14/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 47.90

The feasibility of simplifying solar energy systems, and the production techniques of their components, for usage in developing countries was investigated. The emphasis in those countries should not be so much on efficiency. Simplicity of construction and minimal reliance on imported components should be emphasized rather than efficiency because of favorable radiation conditions and high ambient temperatures. Several systems were tested consisting only of collectors, heat storage and a simple flow control. The construction of the collectors was reviewed for materials, heat vector, efficiency, construction and assembly techniques, and the material resources and climate of individual countries. As a result, a prototype collector was built and tested, satisfying the requirements. Author (ESA)

N82-19892# Dortmund Univ. (West Germany). Inst. fuer Umweltschutz.
A SOLAR HIGH TEMPERATURE KILN Final Report
Norbert Huettenhoelscher and Konrad Bergmann. Bonn Bundesministerium fuer Forschung und Technologie Nov. 1981 93 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-181; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 19.75

The feasibility of using solar energy in developing countries for baking ceramic construction materials was investigated. The solar high temperature kiln is described. It uses two parabolic concentrators which direct available radiation into the baking chamber. The Sun tracker has only one axis. Preliminary test results with the prototype kiln were satisfactory. Author (ESA)

N82-19893# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
JOINT INDIAN-GERMAN PROGRAM ON SOLAR ENERGY: PHASE 2 Final Report
Knut Barndorfer. Bonn Bundesministerium fuer Forschung und Technologie Nov. 1981 99 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-182; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 21

Based on the analysis of the total energy needs of a typical Indian village and of the local sources: sun, wind and biomass, several energy supply concepts were analyzed. A project proposal for short and long-term development and testintg of components and systems was elaborated. Test results and experience with the 10 kW solar power plant of Madras are presented, including recommendations for further work regarding low temperature systems. The work carried out on a parabolic dish test stand at Hyderabad is reported. Author (ESA)

N82-20638 Virginia Polytechnic Inst. and State Univ., Blacksburg.
STAGNATION TEMPERATURE TEST METHODS FOR DETERMINING SOLAR COLLECTOR THERMAL PERFORMANCE DEGRADATION Ph.D. Thesis
Aaron Grayson Dawson, III 1981 156 p
Avail: Univ. Microfilms Order No. 8126252

An analytical and experimental investigation was undertaken to evaluate a proposed method for determining the thermal degradation of materials used in flat-plate solar collectors. The proposed method is based on measuring stagnation (no-flow) temperatures of the absorber plate. A comparison of the advantages and limitations of the proposed method is made with the conventionally used existing method which is based on measuring the energy output from the collector. Previous investigations show that the existing test method may not be sufficiently sensitive to detect expected changes in material properties, is influenced by the test environment, and is relatively expensive to perform. The material properties of interest are primarily the cover transmittance, the solar absorptance of the absorber, the infrared emittance of the absorber, and the thermal conductivity of insulation. Dissert. Abstr.

N82-20639 Virginia Polytechnic Inst. and State Univ., Blacksburg.
ANALYTICAL AND EXPERIMENTAL ANALYSIS OF PROCEDURES FOR TESTING SOLAR DOMESTIC HOT WATER SYSTEMS Ph.D. Thesis
Arthur Hunter Fanney, II 1981 181 p
Avail: Univ. Microfilms Order No. 8126255

Three experimental techniques which allow the net thermal output of an irradiated solar collector array, without the use of a solar simulator, to be reproduced indoors are investigated. These techniques include use of an electric heat source only, use of a nonirradiated collector array in series with an electric heat source, and the use of electric strip heaters which are attached to the back of nonirradiated absorber plates. Expressions are developed to compute the input power required for each experimental technique. Solar collectors connected in parallel and series combinations are considered. Experiments conducted to determine the effect of storage tank, temperature stratification on system performance for a single tank direct solar hot water system are described. Dissert. Abstr.

N82-20642*# AiResearch Mfg. Co., Torrance, Calif.
BUFFER THERMAL ENERGY STORAGE FOR AN AIR BRAYTON SOLAR ENGINE Final Report
Hal J. Strumpf and Kevin P. Barr 31 Aug. 1981 79 p refs Prepared for JPL
(Contracts NAS7-100; JPL-995136)
(NASA-CR-168657; NAS 1.26:168657; AIRESEARCH-81-18087) Avail: NTIS HC A05/MF A01 CSCL 10C

The application of latent-heat buffer thermal energy storage to a point-focusing solar receiver equipped with an air Brayton engine was studied. To demonstrate the effect of buffer thermal energy storage on engine operation, a computer program was written which models the recuperator, receiver, and thermal storage device as finite-element thermal masses. Actual operating or predicted performance data are used for all components, including the rotating equipment. Based on insolation input and a specified control scheme, the program predicts the Brayton engine operation, including flows, temperatures, and pressures for the various components, along with the engine output power. An economic parametric study indicates that the economic viability of buffer thermal energy storage is largely a function of the achievable engine life. A.R.H.

N82-20643*# AiResearch Mfg. Co., Torrance, Calif.
STEAM RANKINE SOLAR RECEIVER, PHASE 2 Final Technical Report
L. E. DeAnda and M. Faust 23 Nov. 1981 95 p refs Prepared for JPL
(Contracts NAS7-100; JPL-955157)
(NASA-CR-168656; NAS 1.26:168656; AIRESEARCH-80-17527) Avail: NTIS HC A05/MF A01 CSCL 10A

A steam rankine solar receiver (SRSR) based on a tubular concept was designed and developed. The SRSR is an insulated, cylindrical coiled tube boiler which is mounted at the focal plane of a fully tracking parabolic solar reflector. The concentrated solar energy received at the focal plane is then transformed to thermal energy through steam generation. The steam is used in

a small Rankine cycle heat engine to drive a generator for the production of electrical energy. The SRSR was designed to have a dual mode capability, performing as a once through boiler with and without reheat. This was achieved by means of two coils which constitute the boiler. The boiler core size of the SRSR is 17.0 inches in diameter and 21.5 inches long. The tube size is 7/16 inch I.D. by 0.070 inch wall for the primary, and 3/4 inch I.D. by 0.125 inch wall for the reheat section. The materials used were corrosion resistant steel (CRES) type 321 and type 347 stainless steel. The core is insulated with 6 inches of cerablanket insulation wrapped around the outer wall. The aperture end and the reflector back plate at the closed end section are made of silicon carbide. The SRSR accepts 85 kwth and has a design life of 10,000 hrs when producing steam at 1400 F and 2550 psig. S.L.

N82-20646*# Solarex Corp., Rockville, Md.
A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT (MEPSDU) Quarterly Report, 1 Sep. - 30 Nov. 1981
30 Nov. 1981 25 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955902)
(NASA-CR-168667; DOE/JPL-955902-81/4; NAS 1.26:168667; QR-4) Avail: NTIS HC A02/MF A01 CSCL 10A

The development of a cost effective process sequence that has the potential for the production of flat plate photovoltaic modules which meet the price goal in 1986 of 70 cents or less per Watt peak is described. The major accomplishments include (1) an improved AR coating technique; (2) the use of sand blast back clean-up to reduce clean up costs and to allow much of the Al paste to serve as a back conductor; and (3) the development of wave soldering for use with solar cells. Cells were processed to evaluate different process steps, a cell and minimodule test plan was prepared and data were collected for preliminary Samics cost analysis. A.R.H.

N82-20649*# Springborn Labs., Inc., Enfield, Conn.
INVESTIGATION OF TEST METHODS, MATERIAL PROPERTIES, AND PROCESSES FOR SOLAR CELL ENCAPSULANTS Quarterly Progress Report
P. B. Willis Oct. 1981 46 p refs Sponsored in part by DOE
(Contract JPL-954527; JPL Proj. 6072-1)
(NASA-CR-168671; DOE/JPL-954527-81/20; JPL-9950-648; NAS 1.26:168671; QPR-21) Avail: NTIS HC A03/MF A01 CSCL 10A

Encapsulant materials and processes for the production of cost-effective, long-life solar cell modules were investigated. The following areas were explored: (1) soil resistant surface treatment; (2) corrosion protecting coatings from mild steel substrates; (3) primers for bonding module interfaces; and (4) RS/4 accelerated aging of candidate encapsulation compounds. B.W.

N82-20651*# Siltec Corp., Menlo Park, Calif.
LSA LARGE AREA SILICON SHEET TASK ENHANCED ID SLICING TECHNOLOGY FOR SILICON INGOTS Final Report
George F. Fiegl Dec. 1981 43 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955282)
(NASA-CR-168668; NAS 1.26:168668; DOE/JPL-955282-81/1) Avail: NTIS HC A03/MF A01 CSCL 10A

A commercially available saw was equipped with a programmable ingot advance/rotation unit and a closed loop cutting edge position control system. Extensive experimentation with ingot rotation revealed that, due to the combination of the anisotropic material character of the monocrystalline silicon and ingot rotation during cutting, severe limitations on productivity were imposed. Cutting edge position control, with low kerf blades reduced the deflection by one order of magnitude thus contributing significantly to the kerf reduction. While prefabricated blade inserts promise great potential for increasing the blade lifetime while decreasing kerf, more fundamental work in the materials area of the bond is required before these blades become an effective production tool. An alternative solution of etched core construction permitted low kerf slicing, but further refinement for greater lifetime is necessary. A.R.H.

N82-20655*# National Aeronautics and Space Administration, Washington, D. C.
DYNAMIC ELECTRICAL RESPONSE OF SOLAR CELLS
Jean-Pierre Catani Jun. 1981 42 p Transl. into ENGLISH from CNES Note Technique no. 85 (France), Oct. 1978 p 1-41, 69-87 Translation was announced as N80-11629 Transl. by SCITRAN, Santa Barbara, Calif.
(Contract NASw-3198)
(NASA-TM-76686; NAS 1.15:76686) Avail: NTIS HC A03/MF A01 CSCL 10A

The dynamic response of a solar generator is of primary importance as much for the design and development of electrical power conditioning hardware as for the analysis of electromagnetic compatibility. A mathematical model of photo-batteries was developed on the basis of impedance measurements performed under differing conditions of temperature, light intensity, before and after irradiation. This model was compared with that derived from PN junction theory and to static measurements. These dynamic measurements enabled the refinement of an integration method capable of determining, under normal laboratory conditions, the dynamic response of a generator to operational lighting conditions. Author

N82-20662*# Kayex Corp., Rochester, N. Y.
LOW COST CZOCHRALSKI CRYSTAL GROWING TECHNOLOGY. NEAR IMPLEMENTATION OF THE FLAT PLATE PHOTOVOLTAIC COST REDUCTION OF THE LOW COST SOLAR ARRAY PROJECT Final Report, 12 Mar. 1979 - 30 Sep. 1980
E. G. Roberts 30 Sep. 1980 190 p refs Sponsored in part by DOE Prepared for JPL
(NASA-CR-168658; NAS 1.26:168658; JPL-9950-632; DOE/JPL-955270-8078) Avail: NTIS HC A09/MF A01 CSCL 10A

Equipment developed for the manufacture of over 100 kg of silicon ingot from one crucible by rechanging from another crucible is described. Attempts were made to eliminate the cost of raising the furnace temperature to 250 C above the melting point of silicon by using an RF coil to melt polycrystalline silicon rod as a means of rechanging the crucible. Microprocessor control of the straight growth process was developed and demonstrated for both 4 inch and 6 inch diameter. Both meltdown and melt stabilization processes were achieved using operator prompting through the microprocessor. The use of the RF work coil in poly rod melting as a heat sink in the accelerated growth process was unsuccessful. The total design concept for fabrication and interfacing of the total cold crucible system was completed. A.R.H.

N82-20663*# Burt, Hill, Kosar, Rittleman, and Associates, Butler, Pa. Research and Solar Applications Div.
COMMERCIAL/INDUSTRIAL PHOTOVOLTAIC MODULE AND ARRAY REQUIREMENT STUDY. LOW-COST SOLAR ARRAY PROJECT ENGINEERING AREA Final Report
Dec. 1981 326 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955698)
(NASA-CR-168664; NAS 1.26:168664; DOE/JPL-955698) Avail: NTIS HC A15/MF A01 CSCL 10B

Design requirements for photovoltaic modules and arrays used in commercial and industrial applications were identified. Building codes and referenced standards were reviewed for their applicability to commercial and industrial photovoltaic array installation. Four general installation types were identified - integral (replaces roofing), direct (mounted on top of roofing), stand-off (mounted away from roofing), and rack (for flat or low slope roofs, or ground mounted). Each of the generic mounting types can be used in vertical wall mounting systems. This implies eight mounting types exist in the commercial/industrial sector. Installation costs were developed for these mounting types as a function of panel/module size. Cost drivers were identified. Studies were performed to identify optimum module shapes and sizes and operating voltage cost drivers. The general conclusion is that there are no perceived major obstacles to the use of photovoltaic modules in commercial/industrial arrays. R.J.F.

N82-20664*# Mobil Tyco Solar Energy Corp., Waltham, Mass.
LARGE AREA SILICON SHEET BY EFG Annual Progress Report, 1 Oct. 1980 - 30 Sep. 1981
30 Sep. 1981 71 p refs Prepared for JPL
(Contract JPL-954355)

(NASA-CR-168680; NAS 1.26:168680; DOE/JPL-954355-81) Avail: NTIS HC A04/MF A01 CSCL 10A

Progress was made in improving ribbon flatness and reducing stress, and in raising cell performance for 10 cm wide ribbon grown in single cartridge EFG furnaces. Optimization of growth conditions resulted in improved ribbon thickness uniformity at a thickness of 200 micron, grown at 4 cm/minute, and growth at this target speed is routinely achieved over periods of the order of one hour or more. With the improved ribbon flatness, fabrication of large area (50 sq cm) cells is now possible, and 10 to 11% efficiencies were demonstrated on ribbon grown at 3.5 to 4 cm/minute. Factors limiting performance of the existing multiple ribbon furnace were identified, and growth system improvements implemented to help raise throughput rates and the time percentage of simultaneous three-ribbon growth. However, it is evident that major redesign of this furnace would be needed to overcome shortfalls in its ability to achieve the Technical Features Demonstration goals of 1980. It was decided to start construction of a new multiple ribbon furnace and to incorporate the desired improvements into its design. The construction of this furnace is completed. J.M.S.

N82-20671# Air Force Engineering and Services Center, Golden, Colo.

STATE-OF-THE-ART REVIEW OF SOLAR PONDS Final Report

William A. Tolbert Apr. 1981 16 p refs

(AF Proj. 2064)

(AD-A109038; DOE/SSO-4042/1) Avail: NTIS HC A02/MF A01 CSCL 13/2

This report provides a brief but concise review of solar pond technologies and their potential for application within the military. The report covers salt gradient solar ponds (SGSP), shallow solar ponds (SSP), saltless convecting solar ponds, gel ponds, viscosity stabilized ponds, and membrane ponds. In addition, several criteria were evaluated with respect to solar ponds. These included reliability, maintainability, efficiency, survivability, environmental impact and economics. Research and development requirements and ongoing activities were also summarized. This report documents one of several ongoing state-of-the-art reviews of solar technologies performed by an Air Force liaison office with the Department of Energy. Author (GRA)

N82-20672# Air Force Engineering and Services Center, Golden, Colo. Research and Technology Liaison Office.

STATE-OF-THE-ART REVIEW OF LOW-COST COLLECTOR TECHNOLOGIES Final Report

William A. Tolbert Jun. 1981 13 p refs

(AF Proj. 2064)

(AD-A109039; DOE/SSO-4042/2) Avail: NTIS HC A02/MF A01 CSCL 13/2

This report provides a brief but concise review of low-cost solar collector technologies and their potential for application within the military. The report covers low-cost, light-weight concepts for flat-plate collectors, parabolic trough collectors, heliostats and parabolic dish collectors. In addition, several criteria were evaluated with respect to low-cost collector technologies. These included reliability, maintainability, survivability, mobility/erectibility, environmental impact and economics. Research and development requirements and ongoing activities were also summarized. This report documents one of several ongoing state-of-the-art reviews of solar technologies performed by an Air Force liaison office with the Department of Energy. Author (GRA)

N82-20674# Texas Univ. at Arlington. Dept. of Chemistry.

THE DESIGN OF SEMICONDUCTOR PHOTOELECTROCHEMICAL SYSTEMS FOR SOLAR ENERGY CONVERSION

Allen J. Bard 21 Dec. 1981 34 p refs Submitted for publication

(Contract N00014-78-C-0592; NR Proj. 051-693)

(AD-A109477; TR-20) Avail: NTIS HC A03/MF A01 CSCL 20/12

The principles and applications of semiconductor electrodes in photoelectrochemical (PEC) cells for carrying out useful chemical reactions are described. The factors in the design of efficient and stable systems and semiconductor particulate systems constructed on the basis of PEC cell principles are discussed. Author (GRA)

N82-20684*# Ross (Bernd) Associates, San Diego, Calif.

DEVELOPMENT OF AN ALL-METAL THICK-FILM COST-EFFECTIVE METALLIZATION SYSTEM FOR SOLAR CELLS Quarterly Report, Nov. 1980 - Apr. 1981

Bernd Ross Sep. 1981 39 p refs

(Contracts NAS7-100; JPL-955688)

(NASA-CR-168502; NAS 1.26:168502; DOE/JPL-955688-80/10; DE-82-001936; QR-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Screened electrodes made from fluorocarbon activated copper paste and silver fluoride activated copper paste, tape adhesion and scratch tests were studied. Experiments were conducted with variations in past parameters, firing conditions, including gas ambients, furnace furniture, silicon surface and others. A liquid medium intended to provide transport during the carbon fluoride decomposition, is incorporated in the paste. DOE

N82-21225# Lincoln Lab., Mass. Inst. of Tech., Lexington.

MATERIALS, PROCESSES AND TESTING LABORATORY RESIDENTIAL TECHNICAL PROGRESS REPORT Progress Report, Mar. - Jun. 1981

S. E. Forman and M. P. Themelis 31 Aug. 1981 29 p refs

(Contract DE-AC02-76ET-20279)

(DE82-002816; DOE/ET-20279/151) Avail: NTIS HC A03/MF A01

Performance measurements are reported for prototype photovoltaic modules in various residential applications in the Northeast, in New Mexico, in Florida and in Hawaii. Current-voltage characteristics were measured and the dependence of power delivered upon cell temperature was measured. Failure analysis of high leakage current modules, visual examination results of modules at the Northeastern and New Mexico sites, and examination of photovoltaic/thermal liquid collectors are presented. T.M.

N82-21345*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

EVALUATION OF THE EFFECTS OF A FREEZE/THAW ENVIRONMENT ON CELLULAR GLASS

P. Frickland, E. Cleland, and T. Hasegawa 15 Aug. 1981 41 p refs

(Contract DE-AT04-81AL-16228)

(NASA-CR-168719; DOE/JPL-1060-44; NAS 1.26:168719; DE81-03093) Avail: NTIS HC A03/MF A01 CSCL 11B

Cellular glass technology with respect to solar energy applications was briefly reviewed and current applications and related studies are discussed. Using the evaluation criteria of water vapor permeability and conformability, a protective butyl rubber/silicone conformal coating system was selected for use on Foamglas substrates in a freeze/thaw environment. The selection of a specific freeze/thaw cycle which closely models field conditions is discussed. A sampling plan is described which allows independent evaluation of the effects of conformal coatings, cycle number and location within the environmental chamber. The results of visual examination, measurement of density, modulus of rupture and Young's modulus are reported. Based upon statistical evaluation of the experimental results, it is concluded that no degradation in mechanical properties of either coated or uncoated Foamglas occurred within the duration of the test (53 freeze/thaw cycles). T.M.

N82-21441# Lincoln Lab., Mass. Inst. of Tech., Lexington.

PROTOTYPE RESIDENTIAL PHOTOVOLTAIC-SYSTEMS EVALUATION PLANS

M. C. Russell Oct. 1981 33 p refs

(Contract DE-AC02-76ET-20279)

(DE82-004726; DOE/ET-20279/163) Avail: NTIS HC A03/MF A01

A sequence of tests is identified to assess the reliability and safety of residential photovoltaics systems. In addition, a standard means of characterizing a PV system in terms of its power and energy performance is presented. At present, these tests and characterization procedures are being applied to prototype residential systems under evaluation. DOE

N82-21442# Massachusetts Inst. of Tech., Cambridge.

SOLAR PHOTOVOLTAIC RESIDENTIAL PROJECT Monthly Management Report, 1 Jul. 1981 - 31 Jul. 1981

1981 17 p

(Contract DE-AC02-76ET-20279)

(DE82-000653; DOE/ET-20279/T11) Avail: NTIS HC A02/MF A01

Progress with technology transfer and the performance of photovoltaic power supplies in Northeastern and Southwestern residences are reported. Also, systems operation in Florida and Hawaii are discussed briefly. Technology development in the field of power conditioning and flywheel storage is described. Work on some non-residential field tests is also described. Project management data are summarized. DOE

N82-21443# Lincoln Lab., Mass. Inst. of Tech., Lexington.
CARLISLE HOUSE: AN ALL-SOLAR-ELECTRIC RESIDENCE
B. E. Nichols Oct. 1981 25 p refs
(Contract DE-AC02-76ET-20279)
(DE82-004376; DOE/ET-20279/143) Avail: NTIS HC A02/MF A01

The first solar photovoltaic house designed and constructed under the US Department of Energy's Solar Photovoltaic Residential Project was completed. The house, which is powered by a 7-kWp photovoltaic system, will be used to assess the occupants' acceptance of and reactions to residential photovoltaic systems and to familiarize utilities, builders, developers, town building officials and others with issues concerning photovoltaic installations. The house is located on a two-acre lot in Carlisle, Massachusetts, approximately twenty miles northwest of Boston. Built by a local architect/developer team, the house includes energy conservation and passive solar features. It utilizes a roof-mounted, flat-plate PV array which operates in a two-way energy exchage mode with the electric utility. The energy conservation and passive solar features of this house are described and detailed description of the utility-interactive photovoltaic system is presented, along with initial performance data. DOE

N82-21542# Sandia Labs., Livermore, Calif. Thermal Sciences Div.
RADSOLVER: A COMPUTER PROGRAM FOR CALCULATING SPECTRALLY-DEPENDENT RADIATIVE HEAT TRANSFER IN SOLAR CAVITY RECEIVERS
M. Abrams Sep. 1981 58 p refs
(Contract DE-AC04-76DP-00789)
(DE82-000833; SAND-81-8248) Avail: NTIS HC A04/MF A01

RADSOLVER is a computer program which calculates the radiation energy transport in cavity type receivers having an arbitrary number of apertures through which collimated beams of solar radiation enter. In contrast to the common assumption of gray (or semi-gray) surfaces used in the modeling of radiation transport, RADSOLVER accounts for the wavelength-depndence of emission, absorption and reflection with a band model of the radiative properties. Illustrative examples along with input and output are presented. DOE

N82-21715# Uppsala Univ. (Sweden). Inst. of Technology.
OPTICAL PROPERTIES OF SOLIDS FOR SOLAR ENERGY CONVERSION Ph.D. Thesis
Bjoem Karlsson 1981 19 p refs Sponsored in part by the Swedish Natural Science Research Council (NFR), the Swedish Council for Building Research (BRF), and the Swedish Board for Technical Development (STU)
(ISSN-0345-0058; ISBN-91-554-1226-2) Avail: NTIS HC A02/MF A01

The optical properties of transition metal carbides and nitrides were studied by reflectance measurements between 0.2 and 15 micrometers at room temperature and up to 500 C. An interpretation of the pronounced difference between the nitrides and carbides is made from a model in the electronic density of states distribution. The model is used to explain shifts in the optical constants when carbon or nitrogen-vacancies are introduced in the nitride. Calculations based on the optical constants suggest the nitrides as a new material for transparent heat-mirrors. The refractive index and band-edge of CuO, Cu sub 2O, Fe sub 2O sub 3, Cr sub 2O sub 3, i-C and a-Si have been measured and discussed within the framework of a new model for evaluating their potential use as the absorbing layer on a tandem-selective surface. A number of oxides on copper and steel were prepared by thermal and chemical methods and investigated for use as selectively absorbing surfaces. Thin films of noble and transition metals have been prepared and optically investigated for use as semi-transparent coatings on domestic windows. Author

N82-21716# Los Alamos Scientific Lab., N. Mex.
A PASSIVE SOLAR RETROFIT STUDY FOR CONCRETE BLOCK BUILDINGS Report, Oct. 1980 - Sep. 1981
William O. Wray, Charles R. Miles (NCEL), and Claudia E. Kosiewicz Jan. 1982 ~~42~~ p refs
(Contract N68305-81-MP-10003)
(AD-A110189; CEL-CR-82.007) Avail: NTIS HC A03/MF A01 CSCL 13/1

A passive solar retrofit study has been conducted for the Navy at the Los Alamos National Laboratory. The purpose of the study was to determine the energy savings obtainable in concrete block buildings from several passive solar heating and conservation strategies. A procedure involving the use of test cell data and computer simulation was employed to assess the merits of six retrofit options. The six strategies selected were chosen on the basis of providing a series of options that will deliver increasing energy savings at the cost of correspondingly increased levels of commitment. Author (GRA)

N82-21720# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR ENERGY INFORMATION USER STUDY: MILITARY ENGINEERS
T. L. Marle and W. W. Below Sep. 1981 100 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-001606; SERI/TR-761-1047) Avail: NTIS HC A05/MF A01

Data from questionnaires administered to military engineers and architects attending a 2 day solar design workshop are summarized. The workshop was designed to inform engineers when and where solar energy could be used more effectively. The study aimed to identify the solar energy information needs and information habits of the professionals, their familiarity with and appraisal of relevant military publications containing solar energy information currently available, and the overall effectiveness of the workshops (including structure and content). To measure the effectiveness of the workshop itself and provide input on producing an effective and comprehensive information dissemination plan for military engineers nationwide, 2 questionnaires were designed and administered to the participants. A preworkshop questionnaire assessed the participant's knowledge of solar energy prior to attending the workshop. T.M.

N82-21721# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ECONOMIC ASSESSMENT OF BATTERY STORAGE IN SOLAR PHOTOVOLTAIC APPLICATIONS First-year Project Summary
R. O. Mueller, W. J. Walsh, B. K. Cha, and R. F. Giese May 1981 56 p refs
(Contract W-31-109-eng-38)
(DE82-004045; ANL/SPG-20) Avail: NTIS HC A04/MF A01

Savings attributable to batteries were evaluated for three representative US utility service areas. The photovoltaic (PV) devices were assumed capable of exporting excess power to the utility grid; and the batteries, sited at the substation, were operated as a form of load-leveling utility storage. A cost-allocation model, SIMSTOR, was employed to determine utility fuel and resulting capital cost savings. The effects of installing PV devices were evaluated. Results indicated that batteries and PV systems do not directly compete when attached to the electricity supply grid. Utility savings were primarily fuel savings; those from the batteries were savings in utility capacity. Batteries with higher discharge rates and larger storage capacities are to be favored. It was determined that lead/acid and zinc/chlorine batteries are the leading contenders in the near term. M.D.K.

N82-21727# Arizona Univ., Tucson. Environmental Research Lab.
OFF-PEAK POWER USE IN PASSIVE SOLAR HOMES: PERFORMANCE, MONITORING, AND ANALYSIS OF PERIODIC HEATING AND COOLING IN HIGH MASS HOMES
J. F. Peck Aug. 1981 42 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1191-7)
(DE82-900874; EPRI-EM-1988) Avail: NTIS HC A03/MF A01

The thermal performance of two passive solar homes and an identical standard home used as a control are described.

The peak hour electrical demand rates of these homes are compared and off peak refrigeration of homes with large quantities of thermal mass is discussed. A computer model which is being developed to assess the potential of off peak refrigeration is also described.
DOE

N82-21729# Princeton Univ., N. J. Energy Group.
HEATING/DAYLIGHTING PROTOTYPE DEVELOPMENT, PHASE 1. PASSIVE AND HYBRID SOLAR MANUFACTURED BUILDING PROJECT COVERING RESEARCH AND COMPONENT DESIGN Final Technical Report, 1 Oct. 1978 - 31 Aug. 1981
L. L. Lindsey and Marvin K. Snyder (Butler Manufacturing Co. Research Center) Sep. 1981 79 p refs
(Contract DE-FC02-80CS-30367)
(DE82-002097; DOE/CS-30367/6) Avail: NTIS HC A05/MF A01

The design of passive and hybrid solar space heating and daylighting into prefabricated buildings is described. Systems considered include one sided and two sided roof apertures and a wall mounted air collector system. Several storage concepts were considered, and best results are expected from using the floor slab and perhaps rock beds. A test building design is described. Performance simulation and thermal analysis on the design are described and annual performance estimates and cost estimates are made.
DOE

N82-21730# DHR, Inc., Washington, D.C.
MATERIALS-RESEARCH RECOMMENDATIONS TO IMPROVE THE PERFORMANCE AND DURABILITY OF SOLAR HEATING AND COOLING SYSTEMS
Stephen Herzenberg and Richard Silberglitt 11 Sep. 1981 258 p refs
(Contract DE-AC01-80ER-30008)
(DE82-000738; DOE/ER-30008/T1) Avail: NTIS HC A12/MF A01

The type of materials research most likely to improve the durability and efficiency of future active and passive solar heating and cooling systems is analyzed. Research needs are compared with ongoing solar materials research, and the extent to which present research efforts are addressing the critical flat plate collector needs is assessed. Areas most in need of additional attention are identified. Research recommendations are made for glazing materials, selective absorbers and heat transfer fluids.
DOE

N82-21731# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SAFETY PROCEDURES FOR THE 100-KW SOLAR PHOTOVOLTAIC SYSTEM AT NATURAL BRIDGES NATIONAL MONUMENT
R. F. Hopkinson Sep. 1981 47 p refs
(Contract DE-AC02-78ET-20279)
(DE82-002840; DOE/ET-20279/106) Avail: NTIS HC A03/MF A01

The 100-kWp solar photovoltaic (PV) power system at Natural Bridges National Monument is a unique electrical power-generation system and special safety guidelines were developed to govern its operation. General safety requirements are set forth to safeguard newcomers to the PV system. Procedures to be used in event of emergency, including a recommended shutdown procedure, are included together with specific safety hazards inherent in the array field, battery room, control room and inverter room.
DOE

N82-21733# Exxon Research and Engineering Co., Florham Park, N.J.
CONCEPTUAL DESIGN OF A SOLAR COGENERATION FACILITY INDUSTRIAL PROCESS HEAT, CATEGORY A. EXECUTIVE SUMMARY Final Report, 10 Sep. 1980 - 14 Aug. 1981
P. Joy, Martin Brzeczek, Harold Sellestad, Carl Silverman, and George Yenetchi Jul. 1981 235 p Prepared in cooperation with Badger Energy, Inc., Martin Marietta, Denver and Pacific Gas and Electric, San Ramon, Calif.
(Contract DE-AC03-80SF-11438)
(DE82-001663; DOE/SF-11438/T1-Vol-1) Avail: NTIS HC A11/MF A01

The conceptual design of a central receiver solar cogeneration facility at a California oil field is described. The process of selecting the final cogeneration system configuration is described and the various system level and subsystem level tradeoff studies are presented, including the system configuration study, technology options, and system sizing. The facility is described, and the functional aspects, requirements operational characteristics, and performance are discussed. Capital and operating costs, safety, environmental, regulatory issues and potential limiting considerations for the design are included. Each subsystem is described in detail including a discussion of the functional requirements, design, operating characteristics performance estimates and a top level cost estimate. An economic assessment is performed to determine the near-term economic viability of the project and to examine the impact of variations in major economic parameters such as capital and operating and maintenance costs on economic viability. Two measures of economic viability used are levelized energy cost and net present value.
DOE

N82-21734# Lincoln Lab., Mass. Inst. of Tech., Lexington.
INFORMATION GATHERING, DATA REDUCTION, AND INFORMATION DISSEMINATION FOR RESIDENTIAL EXPERIMENT STATION OPERATIONS
P. Reghurman and E. C. Kern, Jr. Sep. 1981 26 p refs
(Contract DE-AC02-78ET-20279)
(DE82-002157; DOE/ET-20279/141) Avail: NTIS HC A03/MF A01

The Residential Experiment Stations (RESs) were designed to develop residential photovoltaic systems and to disseminate information to the photovoltaic community, cognizant institutions and, ultimately, the public. The residential data systems are discussed that were designed specifically for the RESs to gather and process the physical data required. The specific reports are covered which will be issued and the contents of each report are listed. A sample format for each report is also presented. The appendices describe the quantities that will be measured at the monitored houses, prototype systems and initial system evaluation experiments. They also include a description of the data processing.
DOE

N82-21735# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
ROBINS AIR FORCE BASE SOLAR COGENERATION FACILITY, VOLUME 1 Final Report
Aug. 1981 321 p refs 2 Vol.
(Contract DE-AC03-81SF-11494)
(DE82-001922; DOE/SF-11494/T1-Vol-1) Avail: NTIS HC A14/MF A01

A conceptual design and cost estimate for a demonstration solar facility to generate electricity and deliver process steam to the existing base distribution systems is considered. The solar energy system is a central receiver arrangement. The technical approach to the project and the rationale for selecting the site at Robins Air Force Base are discussed. The evaluation of alternative configurations considered to have potential for improving the facility value is summarized. The solar facility is described, including system level functional requirements, design, operation, performance, cost, safety, environmental, institutional, and regulatory considerations. The design, functional requirements and operating characteristics which influence cost or performance for each subsystem are described. The subsystems are the collector, receiver/tower, master control, electric power generation, and facility steam and feedwater subsystems.
DOE

N82-21736# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
ROBINS AIR FORCE BASE SOLAR COGENERATION FACILITY, VOLUME 2 Final Report
Aug. 1981 196 p refs 2 Vol.
(Contract DE-AC03-81SF-11494)
(DE82-001836; DOE/SF-11494/T1-App-A-H) Avail: NTIS HC A09/MF A01

Eight appendices are included. The first is a facility specification which defines the characteristics, and design and environmental requirements for the facility. The facility conceptual design, performance, costs and economic data are provided as well as a description of the existing facility. The second appendix contains the drawings generated in support of the conceptual design. The third presents the MIRVAL computer code used to calculate the incident energy on the solar receiver. The fourth provides details on the predicted performance of the predicted performance of the modified steam turbine and the typical commercial turbine. The fifth contains the annual integration performance model of sizing the facility. The sixth contains steam load data projected

to 1985. A computer model developed to integrate the hour-by-hour, steady-state, performance of the final conceptual cogeneration facility is given in the seventh appendix. Finally, descriptions and vendor data for the balance of the plant equipment arower, master control, electric power generation, and facility steam and feedwater subsystems. DOE

N82-21737# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

CONVINCING THE HOME BUILDER TO BUILD SOLAR HOMES: EVALUATION OF PASSIVE SOLAR WORKSHOP FOR BUILDERS

S. Klein Sep. 1981 97 p refs

(Contract DE-AC02-77CH-00178)

(DE82-001978; SERI/TR-722-892) Avail: NTIS HC A05/MF A01

In 1979-80, a pilot series of workshops for home builders was offered throughout the United States. The primary objectives of the project were to educate the home builder in passive solar design techniques, to promote favorable attitudes toward solar concepts, and to encourage builders to use solar design in residential construction. Builders and designers were targeted because they are the decision makers in the progress of commercializing solar design in new construction. The need is outlined for continued and expanded programs for builders to facilitate usage of solar design in the residential sector, based on information provided in nearly 1100 pre- and post-training forms returned. DOE

N82-21738# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.

SOLAR DESIGN AND INSTALLATION EXPERIENCE: AN OVERVIEW OF RESULTS FROM THE NATIONAL SOLAR DATA NETWORK

H. O. Holte and C. J. Kelly, ed. Jun. 1981 78 p refs

(Contract DE-AC01-79CS-30027)

(DE82-001657; SOLAR/0009-81/37) Avail: NTIS HC A05/MF A01

Results, conclusions and insights drawn from analysis of the various types of solar energy systems are presented. Some sites have been monitored for over four years. Performance information, derived from accurately measured field data, are oresented and may be related to design data for the sites. Information is identified for such factors as the ratio of storage volume to collector area, heating and cooling load and the ratio of collector area to building floor area. DOE

N82-21743# California Univ., Livermore. Lawrence Livermore Lab.

ECONOMIC ANALYSIS OF SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS: A METHODOLOGY TO DETERMINE ANNUAL REQUIRED REVENUE AND INTERNAL RATE OF RETURN

W. C. Dickinson and Kenneth C. Brown 11 Aug. 1981 48 p refs

(Contract W-7405-eng-48)

(DE82-001628; UCRL-52814-Rev-1) Avail: NTIS HC A03/MF A01

An economic evaluation of solar industrial process heat systems, is developed to determine the annual required revenue and the internal rate of return. First, a format is provided to estimate the solar system's installed cost, annual operating and maintenance expenses, and net annual solar energy delivered to the industrial process. The annual required revenue and the price of solar is calculated. The economic attractiveness of the potential solar investment can be determined by comparing the price of solar energy with the price of fossilfuel, both expressed in levelized terms. This requires calculation of the internal rate of return on the solar investment or, in certain cases, the growth rate of return. DOE

N82-21745# Sandia Labs., Albuquerque, N. Mex.

ACTIVE AND PASSIVE COOLING FOR CONCENTRATING PHOTOVOLTAIC ARRAYS

M. W. Edenburn and Michael W. Edenburn Oct. 1981 23 p refs

(Contract DE-AC04-76DP-00789)

(DE82-003922; SAND-81-0530) Avail: NTIS HC A02/MF A01

Optimization, based on minimum energy cost, of active and passive cooling designs for point-focus Fresnel lens photovoltaic arrays and linas-focus, parabolic-trough photovoltaic arrays is discussed, and the two types of cooling are compared. Passive cooling is more cost-effective for Fresnel lens arrays while the reverse is true for parabolic-trough arrays. DOE

N82-21746# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

EXPLORATORY DEVELOPMENT OF THIN-FILM POLYCRYSTALLINE PHOTOVOLTAIC DEVICES Semiannual Topical Report, 1 Oct. 1980 - 1 Jun. 1981

Jun. 1981 56 p refs Prepared in cooperation with RCA Labs.

(Contract DE-AC02-77CH-00178)

(DE82-000092; SERI/PR-0-9100-1) Avail: NTIS HC A04/MF A01.

During this period, heavy emphasis was placed on substrate and epitaxial process and reactor development since these are the major components of this approach to low-cost solar-cell modules. The substrate task seeks to apply the HEM ingot technology to commercial metallurgical grade (MG) silicon to form a substrate suitable for epitaxial growth and solar-cell fabrication. A conceptual study of three epitaxial reactor systems was conducted to provide a sound theoretical and practical basis for continued and future development of reactor systems. Initial cost projections which were conducted based on SAMICS/IPEG methodolgies indicate that attainment of the cost-goal of less than 0.50 $/Wp can be achieved. T.M.

N82-21748# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

PHOTOVOLTAIC RESEARCH AND DEVELOPMENT: MATERIALS RESEARCH Annual Report

Paul Schissel Sep. 1981 18 p refs

(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)

(DE82-001796; SERI/PR-641-1306) Avail: NTIS HC A02/MF A01

Program objectives, milestones, planned research topics and equipment acquisition and specifications are listed. On-going research activities are described, including principal in-house activities on thick-film metallization, photodegradation of polymeric materials, and encapsulation by electrostatic lamination of glass mirrors. DOE

N82-21750# Pennsylvania State Univ., University Park. Materials Research Lab.

PHOTOVOLTAIC AND STRUCTURAL PROPERTIES OF a-Si:H THIN FILMS Quarterly Technical Report, 1 Jun. - 31 Aug. 1981

R. Messier Nov. 1981 21 p refs Prepared for Midwest Reseach Inst., Golden, Colo.

(Contract DE-AC02-77CH-00178)

(DE82-002755; SERI/PR-9227-1-T1, QTR-5) Avail: NTIS HC A02/MF A01

The physical structure of a vapor-deposited thin film is related to adatom mobility, adatom species, and bombardment effects at the growing film surface. Bombardment effects were found to be the dominant factor. For floating film potentials greater than approximately - 20V, Ar(+)-Ion bombardment results in a drastic decrease in observable film microstructure. Adatom significant bombardment. The evolution of film physical structure was studied in detail. Hydrogenated a-Si films prepared by rf-sputtering were investigated as a function of film thickness, substrate type, and roughness. The physical structure was shown to evolve with film thickness as a result of the nucleation, growth, and incomplete coalescence of island-like structures which leads to a supernetwork of larger voids. The structural evolution was essentially unaffected by substrate type for this material in which low adatom mobility is the controlling factor. M.D.K.

N82-21751# Pennsylvania State Univ., University Park. Material Research Lab.

PHOTOVOLTAIC AND STRUCTURAL PROPERTIES OF a-Si:H THIN FILMS Quarterly Technical Progress Report, 1 Dec. 1980 - 28 Feb. 1981

R. Messier and I. S. T. Tsong 1981 7 p refs Prepared for Midwest Research Inst., Golden, Colo.

(Contract DE-AC02-77CH-00178)

(DE82-002698; SERI/PR-9227-1-T3, QTPR-3) Avail: NTIS HC A02/MF A01

The substrate floating potential, V/sub s/, was measured

as a function of RF-sputtering conditions using an electrostatic probe. The large negative V/sub s/ induced at low P/sub Ar/ was responsible for energetic ion-bombardment at the growing film/plasma interface. This bombardment, when below a threshold potential -20V, results in local atomic rearrangement and selective resputtering, leading to minimization of microstructure defects. Results on film characteristics vs. V/sub s/, H-implantation in c-Si, and Si-H bonding vs. P/sub H2/ and T/sub s/ lead to a more complete picture of bombardment and thermal processes in a-Si:H film formation.
DOE

N82-21752# Midwest Research Inst., Golden, Colo. Photovoltaics Research Branch.
PLAN FOR A PHOTOVOLTAIC APPLIED RESEARCH LABORATORY FOR DEVELOPING COUNTRIES
Steve Hogan, K. Firor, T. Ciszek, J. Olson, and S. Wagner Oct. 1981 17 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-003289; SERI/TR-811-1094) Avail: NTIS HC A02/MF A01

The planning of a photovoltaic laboratory in a developing country is discussed. With a budget of $500,000, equipment and materials are purchased for a four-year period. In the fourth year 1000W (peak power) of modules will be produced from blank silicon wafers.
DOE

N82-21783# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
THIN-FILM POLYCRYSTALLINE SILICON SOLAR CELLS Final Report, 15 Apr. 1980 - 15 Apr. 1981
Amal K. Ghosh, Tom Feng, Daniel J. Eustace, and H. Paul Maruska Jul. 1981 78 p refs
(Contracts DE-AC02-77CH-00178; SERI XJ-0-9077-1)
(DE82-000633; SERI/TR-9077-T3) Avail: NTIS HC A05/MF A01

The highest efficiencies achieved with single crystals are 14.1% for ITO/n-Si and 13.3% of SnO2/n-Si, while the corresponding values for polysilicon are 11.2% and 10.1%. For large area single crystal devices the efficiency values are 11.7% and 11.2% for ITO and SnO2 cells, respectively, while for polysilicon the corresponding values are 9.82% and 9.55%. The lower efficiency for large area devices is mainly due to lower J sub sc and FF. Results are presented to show the optimum grid spacing required. From stability studies it is shown that there are two distinct mechanisms for degradation, one optical and the other thermal. The optical degradation could be eliminated if the cells could be protected from UV light and the thermal degradation can be prevented if the cells are operated below 100 C.
DOE

N82-21785# Science Applications, Inc., McLean, Va. Solar Technology Div.
COMPARISON OF GROUND-COUPLED SOLAR-HEAT-PUMP SYSTEMS TO CONVENTIONAL SYSTEMS FOR RESIDENTIAL HEATING, COOLING AND WATER HEATING Final Report
M. K. Choi, J. H. Morehouse, and P. J. Hughes Golden, Colo. Solar Energy Research Inst. Jul. 1981 82 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-003633; SERI/TR-98288-2) Avail: NTIS HC A05/MF A01

An analysis is performed of ground-coupled stand-alone and series configured solar-assisted liquid-to-air heat pump systems for residences. The year-round thermal performance of these systems for space heating, space cooling, and water heating is determined by simulation and compared against non-ground-coupled solar heat pump systems as well as conventional heating and cooling systems in three geographic locations: Washington, DC; Fort Worth, Texas; and Madison, Wisconsin. The results indicate that without tax credits a combined solar/ground-coupled heat pump system for space heating and cooling is not cost competitive with conventional systems. Its thermal performance is considerably better than non-ground-coupled solar heat pumps in Fort Worth. Though the ground-coupled stand-alone heat pump provides 51 percent of the heating and cooling load with non-purchased energy in Fort Worth, its thermal performance in Washington and Madison is poor. DOE

N82-21762# AAI Corp., Baltimore, Md.
SOLAR PRODUCTION OF INDUSTRIAL PROCESS HOT WATER. PHASE 3: OPERATION AND EVALUATION OF THE YORK BUILDING PRODUCTS COMPANY, INCORPORATED. SOLAR FACILITY Final Report, Sep. 1978 - Sep. 1981
J. M. Bollinger, N. Kaplan, and H. A. Wilkening, Jr. Oct. 1981 94 p refs
(Contract DE-AC03-78CS-31217)
(DE82-003000; DOE/CS-31217/T7) Avail: NTIS HC A05/MF A01

The solar facility utilizes 35 collectors with a total aperture area of 8960 sq ft. The system is designed to deliver a water/ethylene glycol solution at 200 F to a heat exchanger, which, in turn, supplies water at 180 F to a rotoclave (underground tank) for the concrete block curing process. A fossil fuel boiler system also supplies the rotoclave with processed hot water to supplement the solar system. The system was operational 92.5% of the days during which the data acquisition system was functional. Sufficient solar heating was available to deliver hot water to the heat exchanger on 448 days, or 81.8% of the days on which reliable data was recorded. Total fuel saved during the three year period was 10,284 gallons. Thus, this program successfully demonstrated the technical feasibility of generating industrial process hot water with solar energy.
DOE

N82-21765# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
HELIOSTAT FIELD LAYOUT FOR SOLAR THERMAL POWER PLANTS [DIE AUSLEGUNG VON HELIOSTATFELDERN FUER SOLARTHERMISCHE KRAFTWERKE]
Hartung, Kindermann, and W. Mayer Jun. 1980 15 p refs In GERMAN; ENGLISH summary
(MBB-UR-453/80-OE) Avail: NTIS HC A02/MF A01

The calculation of the optimum distribution of heliostats, serving a solar tower collector for solar thermal power generation, is considered. A theoretical basis for the problem is posed, encompassing physical characteristics of the heliostats, their number, and intensity of the reflected radiation from each unit in function of their layout. Theoretical results lead to numerical procedures (program package TAUST). Various heliostat field configurations (project EURELIOS and GAST) are then discussed and evaluated in light of this model.
Author (ESA)

N82-21767# Statens Provningsanstalt, Boraas (Sweden). Lab. fuer Fysikalisk Maetteknik.
SP-C12-301: THERMAL PERFORMANCES OF SOLAR ENERGY ABSORBERS [SP-C12-301: SOLFAANGARES TERMISKA PRESTANDA]
Hans E. B. Andersson 5 Nov. 1979 28 p In SWEDISH
(SP-MET-1979:2) Avail: NTIS HC A03/MF A01

The testing scheme applies to the case of absorbers where the heat carrier is a liquid passing from a single inlet to a single outlet. The absorbers are intended as part of a roof and must be tested in a standardized construction. Thermal efficiency, losses and the influence of the angle of incidence are discussed. The total solar flux in the plane of the absorber must be at least 600 W/sqm, normally 800 to 1100 W/sqm. A Sun-simulator may also be used for testing.
Author (ESA)

N82-21769# Esser (Klaus) G.m.b.H. and Co. K.G., Duesseldorf (West Germany).
SOLAR COLLECTORS FOR FLAT ROOFS
G. Dohse and G. Reisewitz Aug. 1980 23 p Transl. into ENGLISH of "Sonnerkollektoren fuer Flachdacher" Rept. BMFT-FB-T-80-043-E West Germany Sponsored Bunderministerium fuer Forschung und Technologie
(PB82-129834; BMFT-FB-T-80-043-E) Avail: NTIS HC A02/MF A01 CSCL 13A

The development and construction of solar collectors for flat roofs and the testing of their service life was discussed. The problematic nature of installation techniques, which meet technical requirements and guarantee good operation, as well as optimization of collector parts was discussed. A technically and economically satisfying solution to the problem of linking up the collector was found.
GRA

N82-22073# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
PREPARATION AND PROPERTIES OF EVAPORATED CdTe FILMS COMPARED WITH SINGLE CRYSTAL CdTe Progress Report, 1 May - 31 Jul. 1981

Richard H. Bube 1981 20 p
(Contracts DE-AC02-77CH-00178; SERI XW-1-9330-1)
(DE82-000228; SERI/PR-9330-1-T3; PR-3) Avail: NTIS HC A02/MF A01

The hot wall vacuum deposition system is discussed and is is good temperature tracking between the furnace core and the CdTe source itself are indicated. Homojunction cells prepared by HWVE deposition of n-CdTe on p-CdTe substrates show no significant change in dark or light properties after open circuit storage for the next 9 months. CdTe single crystal boules were grown with P, As and Cs impurity. For P impurity it appears that the segregation coefficient is close to unity, that the value of hole density is controlled by the P, and that growth with excess Cd gives slightly higher values of hole density than growth with excess Te. CdTe:As crystals appear similar to CdTe:P crystals. DOE

03
HYDROGEN

Includes hydrogen production, storage, and distribution.

A82-19449 The sulfur thermochemical cycle for hydrogen production. M. Dokiya (National Chemical Laboratory for Industry, Yatabe, Ibaraki, Japan). *Energy Developments in Japan*, vol. 4, July 1981, p. 31-42. 18 refs. Translation.

Results of research on sulfur-cycle hydrogen production are presented. An H2S cycle using MoS2 as a catalyst is mentioned as showing promise for thermochemical water splitting, with an equilibrium reaction yield of 7%. Use of I or Pt as catalysts raised efficiencies to 16 and 12%, respectively, and further studies employing hybrid cycles with CO2-S and noble metals are reviewed. Thermal decomposition reactions with sulfuric acid are examined, noting a potential 30% thermal efficiency, and sulfur cycle research being undertaken at various industrial laboratories is outlined. It is noted that experiments with sulfuric acid salts for water electrolysis at Los Alamos will probably use solar collectors as a heat source.
M.S.K.

A82-20075 Photoresponse of n-type semiconductor NiTiO3. P. Salvador (Consejo Superior de Investigaciones Cientificas, Instituto de Catálisis y Petroleoquímica, Madrid, Spain), C. Gutierrez (Consejo Superior de Investigaciones Científicas, Instituto de Química Física, Madrid, Spain), and J. B. Goodenough (Oxford University, Oxford, England). *Applied Physics Letters*, vol. 40, Jan. 15, 1982, p. 188-190. 8 refs.

The 60-Hz photocurrent of 1,000-ohm cm, Nb-doped n-TiO3 has been measured by lock-in amplification as a function of wavelength and applied potential. NiTiO3 is oxidized anodically in the dark producing Ni(2 plus) ions in solution; however, this corrosion is but a fraction of the total charge passed either with visible or UV light, which indicates that photogenerated holes are able to oxidize water. The spectral response is shifted towards the visible region, as compared with TiO2, and the flatband potential is 0.4 V more negative than that of the H(plus)/H2 redox couple, which would make possible the use of NiTiO3 for water photoelectrolysis. However, the quantum efficiency for visible light is much lower than that for UV light, primarily because of low oscillator strength for the visible light Ni(2 plus)-Ti(4 plus) charge transfer excitation in this structure.
(Author)

A82-20137 The prospects for liquid hydrogen fueled aircraft. G. D. Brewer (Lockheed-California Co., Burbank, CA). *International Journal of Hydrogen Energy*, vol. 7, no. 1, 1982, p. 21-41. 12 refs.

It is pointed out that an alternative fuel for transport aircraft must be either producible or available anywhere in the world. It is contended that this requirement can be met by liquid hydrogen because it can be produced from water using any locally available energy source. It is not dependent on the availability of fossil resources. With conventional production technologies, LH2 may cost more per unit energy than hydrocarbon alternatives. Because of the weight advantage, however, aircraft using LH2 will be more efficient and their direct operating costs will be competitive. It is shown that, with advanced technologies, LH2 can provide cost and energy advantages. A plan to develop LH2 technology on an international basis is proposed.
C.R.

A82-20138 Comparison of the expenses required for the on-board fuel storage systems of hydrogen powered vehicles. C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 1, 1982, p. 61-77. 8 refs.

The on-board storage of hydrogen in vehicles requires sophisticated tank systems and appreciable energy expenditure. The energy requirement for the loading of liquid hydrogen in a cryogenic storage tank is substantially higher than the amount needed to charge a corresponding hydride vehicle tank. However, the hydride tank must provide a considerable part of its hydrogen fuel energy content in order to meet the energy requirements due to its own weight. This amount increases rapidly with increasing design range. Considering the total primary energy flow for both cases, it turns out that a clear break-even point exists. For design ranges higher than about 200 km the liquid hydrogen storage requires less energy expense than the hydride storage tank, the difference being very substantial (more than 100%) in the usual 400-600 km range. Similar results are found in the costs of the on-board storage of hydrogen for different design ranges. A comparison of these results with the storage costs studied earlier for large-scale stationary hydrogen storage facilities indicates that, from the specific capacity point of view, the break-even conditions are very similar in both cases, although due to different reasons.
(Author)

A82-21194 Replacement of fossil fuels by hydrogen. R. Dahlberg (Telefunken AG, Heilbronn, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 2, 1982, p. 121-142. 26 refs.

The replacement of fossil fuels by solar hydrogen plantations is considered. A model is proposed in which ten plantation families, situated in suitable deserted zones of the world after the year 2000, would generate enough electrical energy to produce solar cells and materials for the construction of ten new plantations within a decade. The technological growth process for identical solar plantation units could be completed about 50 years after construction of the first plantation. All ten plantation families would, by using their electrical energy for the electrolysis of water, generate an amount of hydrogen per year which is four to five times the energy of the world's present annual consumption of oil. This concept envisions the global replacement of fossil fuels by hydrogen within a period consistent with the remaining time span of fossil fuel availability. Storage and transportation of hydrogen would be economical, and the energy produced would not present any environmental problems. Advantages with respect to gains in international cooperation, world peace, and world economy are also discussed.
J.F.

A82-21196 Estimation of storage costs for large hydrogen storage facilities. C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für technische Physik, Stuttgart, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 2, 1982, p. 191-203. 10 refs.

The paper presents an economic evaluation of alternative hydrogen storage methods (pressurized gas, metal hydride and cryogenic storage) for large stationary (utility-scale) applications. The presentation of cost calculation clarifies the importance and influence of a set of relevant parameters depending on the charging-discharging schedule, the relation of the capacity to power level, etc. The results presented define the useful range of application for each storage method, whereas the corresponding cost composition (power related capital costs, capacity-related capital costs, energy costs) is analyzed and discussed.
(Author)

A82-21649 Gas producing process for large quantities of hydrogen (Gaserzeugungsverfahren für grosse Wasserstoffmengen). K. J. Mundo (Uhde GmbH, Dortmund, West Germany). *Brennstoff-Wärme-Kraft*, vol. 34, Jan. 1982, p. 15-21. 15 refs. In German.

Due to the Federal Republic of Germany's energy economy change-over from oil to other energy carriers, hydrogen will be playing a larger part, and large hydrogen plants will be required for the production of the necessary quantities of liquid hydrocarbons from coal. The development of synthesis gas requirements is estimated for important ranges of application in the next two decades, and the possibilities of satisfying these requirements are discussed in terms of the present state of engineering, assuming that various developments can be successfully concluded. The efficiency of the process for production of larger quantities of hydrogen, and manufacturing costs are also discussed and compared with other forms of energy.
D.L.G.

A82-23782 Photoelectrolysis at Fe2O3/TiO2 heterojunction electrode. F.-T. Liou, C. Y. Yang (Brookhaven National Laboratory, Upton, NY), and S. N. Levine (New York, State University, Stony Brook, NY). *Electrochemical Society, Journal*, vol. 129, Feb. 1982, p. 342-345. 13 refs. Research sponsored by the U.S. Department of Energy.

The fabrication of a heterojunction consisting of a thin film of n-type polycrystalline TiO2 deposited on n-type polycrystalline Fe2O3 to form an anode which can photodecompose water in the presence of light is reported. It has been found that under illumination, incident light passes through the TiO3 film and generates holes in the underlying Fe2O3 which, under an appropriate bias, contribute to the electrode reaction of the TiO2/electrolyte interface. The discontinuity at the conduction bands is estimated to be 0.38 eV and at the valence bands, 0.42 eV, which presents an energy barrier to the migration of holes from the Fe2O3. Tests involving CVD TiO2 films on Fe2O3 substrate were performed under 550 C to avoid formation of iron titanates. A photoresponse initiated at 560 nm indicated a hole contribution from the Fe2O3 substrate.
M.S.K.

A82-24796 **Liquid hydrogen for space flight - The long step from proposal to reality.** J. L. Sloop (International Consultants on Energy Systems, Bethesda, MD). *Journal of the Astronautical Sciences*, vol. 29, Oct.-Dec. 1981, p. 373-381. 8 refs.

A series of technological advancements has made it practical to use liquid hydrogen in manned and unmanned space vehicles. These developments and their implications are discussed in detail. They include (1) the liquefaction of gases, their storage and handling; (2) the demonstration that a liquefied gas could be used successfully in rocket flights; (3) the development of lightweight and large rocket structures; and (4) aircraft and rocket experiments with liquid hydrogen. It is concluded that liquid hydrogen will be used not only for space boosters, but for aircraft, cars, trucks, and buses as well. Proposals to generate hydrogen by nuclear and solar energy are also under investigation.
J.F.

A82-25778 **Hydrogen production by immobilized cells. I - Light dependent dissimilation of organic substances by Rhodopseudomonas palustris.** M. Vincenzini, R. Materassi, M. R. Tredici, and G. Florenzano (Firenze, Università, Florence, Italy). *International Journal of Hydrogen Energy*, vol. 7, no. 3, 1982, p. 231-236. 12 refs.

A82-25779 **Hydrogen by water electrolysis as basis for small scale ammonia production - A comparison with hydrocarbon based technologies.** T. Grundt and K. Christiansen (Norsk Hydro A/S, Oslo, Norway). *International Journal of Hydrogen Energy*, vol. 7, no. 3, 1982, p. 247-257. 5 refs.

The Norsk Hydro elctrolyzer technology is described, along with comparisons of ammonia production using different feedstocks and inherent costs and efficiencies. The electrolyzers are bipolar filter press types with electrodes, diaphragm, and gaskets sandwiched together in each cell with an area of 2.1 sq m. A one-cell load is 1700 A/sq m for a total load of 3600 A, and 235 cells are placed in each electrolyzer. An electrolyte composed of 25% KOH is used, and electrolyzer units have initial efficiencies of 98%, falling off at the rate of 1% every 4 yr, due to stray-currents in the lye and gas ducts and some recombination. The production of 1/2 ton of NH3 is noted to require 1970 cu m of H2 and 657 cu m of N, and the formation process is reviewed. The use of hydrocarbon feedstocks such as natural gas, naphtha, fuel oil, and coal is considered, especially for the gasification of coal, and NH3 formation is shown to be competitive with reforming and partial oxidation processes. M.S.K.

A82-25780 **The Daimler-Benz hydride vehicle project.** H. Buchner and R. Povel (Daimler-Benz AG, Stuttgart, West Germany). *International Journal of Hydrogen Energy*, vol. 7, no. 3, 1982, p. 259-266.

Thirty passenger cars with hydrogen and hydrogen/gasoline hybrid operation and TiFe hydride tanks will be tested in Berlin. A central refueling station will deliver pure hydrogen derived out of the town gas network. High and low temperature hydride tanks will be tested in some vans and passenger cars in Stuttgart. An individual refueling station with integrated heat recovery will demonstrate the possibility of using existing energy infrastructures (electricity, gas) for hydrogen production.
(Author)

A82-25781 **Use of hydrogen in dual-fuel engines.** G. Gopal, P. S. Rao, K. V. Gopalakrishnan, and B. S. Murthy (Indian Institute of Technology, Madras, India). *International Journal of Hydrogen Energy*, vol. 7, no. 3, 1982, p. 267-272.

The dual-fuel method is the easiest and most flexible method for using hydrogen in a diesel engine. In this work, a conventional single cylinder, four-stroke diesel engine has been converted to work on the dual-fuel principle with hydrogen as the inducted fuel. The main objectives of the investigation were to determine the optimum proportions between hydrogen and diesel oil under various engine operating conditions and to study the combustion process in the engine under these conditions. The results show that very satisfactory dual-fuel operation with hydrogen is possible. The thermal efficiencies obtained were comparable with pure diesel operation and up to about half the engine's energy requirement could be derived from hydrogen. The chief problem noticed is that of knocking setting in well before the stoichiometric hydrogen-air ratio. This requires further research for rectification.
(Author)

A82-26586 * **Hydrogen uses and demands through the year 2025.** J. H. Kelley (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), W. J. D. Escher (Escher-Foster Technology Associates, St. Johns, MI), and W. van Deelen (Commission of the European Communities, Brussels, Belgium). *Chemical Engineering Progress*, Jan. 1982, p. 58-61. Research supported by the U.S. Department of Energy and NASA.

The magnitude and markets for applications of hydrogen produced by water-splitting through thermal or electrolytic means are projected up to the year 2025. Uses are divided into energy and nonenergy categories, with U.S. synfuels programs accounting for 66% of the increased demand for hydrogen. Applications for transportation fuel, as a natural gas supplement, in fuel cells, in refinery and synfuels industries, for synthesizing chemicals, and for manufacturing semiconductors are summarized. Electrolytic processes are noted to be more suitable for smaller scale production, where use is on-site or local. An annual growth of 8.4-9.2% is foreseen in the energy sector and 3-3.6% in the nonenergy sector, with a total contribution to the primary energy uses of 12-13% by the year 2025. Hydrogen's negligible environmental impact and the ability to interface hydrogen systems with existing equipment are seen as factors encouraging hydrogen-use growth.
M.S.K.

N82-16270*# Brookhaven National Lab., Upton, N. Y. National Center for Analysis of Energy Systems.
SYSTEMS ANALYSIS OF H2/NATURAL GAS SUPPLEMENTATION AND SEPARATION
M. Beller and J. DAcierno 1981 5 p refs Presented at Ann. Contractors' Rev. Meeting on Thermal and Chem. Storage, Tysons Corner, Va
(Contract DE-AC02-76CH-00016)
(DE81-030031; BNL-29962; CONF-810940-3) Avail: NTIS HC A02/MF A01

A systems analysis of the concept of supplementing natural gas with hydrogen was conducted in terms of present fuel supplies and prices. An added option was analyzed; this involves separation of the hydrogen from the mixed stream for use as a nonenergy commodity. The study concludes that no insurmountable barriers exist for the supplementation concept; the separation option will depend only upon economic factors.
DOE

N82-19196*# Little (Arthur D.), Inc., Cambridge, Mass.
AN ASSESSMENT OF THE CRASH FIRE HAZARD OF LIQUID HYDROGEN FUELED AIRCRAFT Final Report
Feb. 1982 132 p refs
(Contract NAS3-22482)
(NASA-CR-165526; ADL-85161) Avail: NTIS HC A07/MF A01 CSCL 01C

The crash fire hazards of liquid hydrogen fueled aircraft relative to those of mission equivalent aircraft fueled either with conventional fuel or with liquefied methane were evaluated. The aircraft evaluated were based on Lockheed Corporation design for 400 passenger, Mach 0.85, 5500 n. mile aircraft. Four crash scenarios were considered ranging from a minor incident causing some loss of fuel system integrity to a catastrophic crash. Major tasks included a review of hazardous properties of the alternate fuels and of historic crash fire data; a comparative hazard evluation for each of the three fuels under four crash scenarios a comprehensive review and analysis and an identification of areas further development work. The conclusion was that the crash fire hazards are not significantly different when compared in general for the three fuels, although some fuels showed minor advantages in one respect or another
R.J.F.

04
FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

A82-19120 **Special purpose anemometry for wind power studies.** U. Hassan (ERA Technology, Ltd., Leatherhead, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 166-193. 12 refs.

Three relatively low-cost anemometric devices suitable for certain applications in wind power studies are described. The Tatter Flag is made of cotton, is 30 x 38 cm in size, and measures winds by the amount of tattering in the flag. A linear correlation with mean wind speed has been shown to exist, with a certainty of 0.87. Obvious disadvantages such as cattle eating the flag are noted. The TALA (Tethered Aerodynamic Lifting Anemometer) kite senses the aerodynamic force on the kite with a tension gage on the tether line. The tension is calibrated in speed, and the height of the kite is determined from the length of the line and the angle of the kite. The TALA kite is used to make rapid assessment of local flowfields. Finally, the ERA GUST anemometer comprises a perforated sphere on a vertical tube fastened at the bottom to a strain gage bridge circuit. An electrical signal proportional to the gust load provides accurate short term gust behavior. M.S.K.

A82-19254 **The application of mixture theory models and numerical solution techniques to coal gasification reactors.** T. R. Blake (Massachusetts, University, Amherst, MA) and E. W. Peterson (Systems, Science and Software, La Jolla, CA). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 574-578. 23 refs.

A82-19255 **Coal gasification combined cycle power generation simulation.** A. S. Patel (General Electric Co., Schenectady, NY). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 579-581.

A82-19299 **A model for industrial production of fuel grade ethanol from sugar beets.** A. A. Koutinas, P. Yianoulis, and K. Gravalos (Patras, University, Patras, Greece). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 313-318. 6 refs.

A82-19975 **Recycling World Congress, 3rd, Basel, Switzerland, September 29-October 1, 1980, Proceedings. Sessions 1-2 /Day 1/, Sessions 3-4 /Day 2/, and Sessions 5-6 /Day 3/.** Oxted, Surrey, England, Recycling World Congress, 1980. Sessions 1-2 /Day 1/, 134 p.; Sessions 3-4 /Day 2/, 113 p.; Sessions 5-6 /Day 3/, 117 p. $108.25; price of three volumes, $256.50.

The recovery of useful products from refuse was examined in terms of the use of research waste to produce heat, the generation of CH_4 from waste, pyrolysis resource recovery, and fuel production from municipal solid waste. The fabrication of building blocks from cement and asbestos factory wastes was discussed, along with the production of ferro-chromium from slags and the use of secondary lead. Attention was also given to recycling metallic incinerator waste, the pyrolysis of plastic wastes scrap in a fluidized bed, and recycling discarded tires as fuel for a cement plant. Various treatments for the reuse of municipal trash were explored and the recovery of usable chemical wastes was described. Sewage sludge and household wastes were investigated for useful products, compost wastes were chemically analyzed, especially for heavy metals, and methods of recycling plastics in all forms were presented. M.S.K.

A82-20256 **Biological sources of energy from the sea.** E. J. Phlips. *Sea Frontiers*, vol. 28, Jan.-Feb. 1982, p. 36-46.

The use of marine plants and microscopic organisms as possible future energy sources is examined. Parallels are drawn between the coming depletion of fossil fuel resources and the first energy crisis on earth, when evolving cells began to use up the stores of organic molecules in the ocean, and photosynthesis, in the form of plant biomass, is considered as a possible solution to the present energy crisis. The energy potential of marine biomass, specifically the seaweeds, microscopic algae and photosynthetic bacteria, is then assessed, and experimental attempts at the culturing of such organisms, are noted. Microbial energy technologies, principally the replacement of chemical processes requiring fossil fuels with biological conversion systems and direct biomass conversion into hydrogen and methane fuels, are then examined. Possible applications of techniques involving genetic engineering and cell-free systems to future bioenergy research are indicated, and the impetus to the rapid development of solar energy posed by the problems of pollution and availability of present energy sources is emphasized. A.L.W.

A82-22196 † **The use of Doppler spectroscopy to study the characteristics of the polydisperse characteristics of emulsion water and solid microimpurities in aviation fuels (Primenenie metoda Doplerovskoi spektroskopii dlia issledovaniia kharakteristik polidispersnosti emul'sionnoi vody i tverdykh mikroprimesei v aviatoplivakh).** A. N. Korolevich, T. V. Oleinik, and A. Ia. Khairullina. *Zhurnal Prikladnoi Spektroskopii*, vol. 35, Dec. 1981, p. 1016-1023. 11 refs. In Russian.

The feasibility of using Doppler spectroscopy to determine drop sizes of emulsion water and particle sizes of solid microimpurities in kerosene flow through a pipe is confirmed. Measured Doppler spectra are used to reconstruct particle size distribution functions for fractions of microparticles beginning with 2 microns. The method makes possible the rapid continuous monitoring of the disperse phase in aviation fuel and may be suitable in the automated analysis of multicomponent disperse media. B.J.

A82-23238 * **Deposit formation in liquid fuels. III - The effect of selected nitrogen compounds on diesel fuel.** J. H. Worstall, S. R. Daniel, and G. Frauenhoff (Colorado School of Mines, Golden, CO). *Fuel*, vol. 60, June 1981, p. 465-467. 11 refs. Grant No. NsG-3122.

The influence of substituted quinolines, pyrroles, indoles, and pyridines on deposit formation in a diesel fuel is evaluated. Significant increases in deposition rate are found which are dependent upon the basicity of the nitrogen compound within a given compound class. These effects correspond closely with those produced in a Jet A fuel. Removal of highly polar fuel components renders the nitrogen compound influence inoperative. These components are therefore participants in deposit-forming reactions. (Author)

A82-23817 **Exergetic analysis of complex multimaterial processes using nuclear coal gasification as an example (Exergetische Analyse komplexer Mehrstoffprozesse am Beispiel der nuklearen Kohlevergasung).** R. Pruschek (Universität Essen-Gesamthochschule, Essen, West Germany) and F. K. Boese (INTERATOM, Internationale Atomreaktorbau GmbH, Bergisch Gladbach, West Germany). *Brennstoff-Wärme-Kraft*, vol. 33, Oct. 1981, p. 404-411. 22 refs. In German. Research supported by the Bundesministerium für Forschung und Technologie.

A comprehensive exergetic analysis is presented for several variants of nuclear coal gasification. The analysis is based on the availability and costs of energy carrier coals and on the rising costs of energy production. In particular, the exergy of chemically reacting materials as well as of mixtures is calculated, and evaluation quotients are computed. Nuclear coal gasification for several gasification possibilities using ligneous and bituminous coals is also examined. J.F.

A82-23819 # **Injection and thermal breakthrough in fractured geothermal reservoirs.** G. S. Bodvarsson and C. F. Tsang (California, University, Berkeley, CA). *Journal of Geophysical Research*, vol. 87, Feb. 10, 1982, p. 1031-1048. 44 refs. Contract No. W-7405-eng-48.

Reinjection of geothermal wastewater is gradually becoming a preferred means of waste disposal. Fluid movement in most geothermal reservoirs is controlled by fracture. The considered investigation has the objective to study the advancement of the thermal front during injection into a fractured reservoir system. A

reservoir system consisting of equally spaced horizontal fractures intersecting an injection well is considered. A rather simple mathematical model is developed and solved analytically. Numerical calculations are carried out in order to investigate the importance of the assumptions employed in the analytical study and extend the applicability of the results. The results from the analytical work are given in the form of type curves which can be used to design the locations of the injection wells with refererence to the production wells and the injection rate. G.R.

A82-23950 Processes for reducing emissions of particulates and oxides of sulfur and nitrogen for various coal utilization alternatives. R. J. Farrell (Scientific Design Co., Inc., New York, NY) and E. N. Ziegler (New York, Polytechnic Institute, Brooklyn, NY). In: Advances in environmental science and engineering. Volume 4. New York, Gordon and Breach Science Publishers, 1981, p. 46-75. 80 refs.

Problems connected with an increased use of coal as substitute for other fuels are partly related to environmental pollution considerations. A review is conducted of the status of both the current options and emerging technologies with respect to removal of the primary pollutants, including particulates, SO2, and NOx. It is found that utility installations which control particulates at coal combustion sites typically use electrostatic precipitators. Those which control SO2 typically use flue-gas desulfurization units. Tighter emission controls will substantially increase the application of filters, regenerative flue gas desulfurization processes and dry-sorption processes for SO2 removal, and new burner designs and post combustion denitrification for NOx control. Strong incentives exist for the development of a 'breakthrough' in a number of areas. Fluidized-bed combustion or the combustion of solvent-refined coal will each capture portions of the utility market. The employment of coal-liquefaction processes appears probable. G.R.

A82-24059 Oceans '80; International Forum on Ocean Engineering in the '80s, Seattle, WA, September 8-10, 1980, Conference Record. Forum sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 566 p. Members, $35.; nonmembers, $46.67.

Engineering applications for the development of ocean and shoreline based technologies are reviewed. Attention was given to the use of instruments such as automatic profiling equipment, surf transducers, and acoustic measuring equipment for ocean phenomena. Various ocean-based resources were investigated, including thermal stratification, wave power, and minerals. Advancements in arctic based ships and ports were discussed, as were topics of navigation and safety, undersea engineering, and characteristics of new submersibles and underwater bases. Techniques for measuring the performance of current measuring devices were examined, along with marine weather systems, methods of oil spill clean-up, and underwater communications systems. Finally, power systems for ships were outlined, and environmental studies of the ocean and methods of applications of Seasat data were explored. M.S.K.

A82-24296 Corrosion of stainless steels in the geothermal environments of the Salton Sea known geothermal resource area. J. P. Carter, S. D. Cramer, and R. K. Conrad (U.S. Bureau of Mines, Avondale, MD). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper.* 15 p. 20 refs.

A82-24297 Geothermal power plant corrosion experience - A global survey. P. F. Ellis, II and D. M. Anliker (Radian Corp., Austin, TX). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper.* 21 p. 30 refs. Research supported by the U.S. Department of Energy.

An overview of corrosion experience from a number of operating geothermal power plants around the world is presented. These power plants are located in six countries and utilize vapor or liquid dominated resources. General plant descriptions and process stream chemistries are presented, and each subsystem of the geothermal power system is considered for its unique corrosion problems. The subsystems discussed are wells, two-phase flow systems, steam transmission systems, turbines, gas extractors, and heat rejection system (condensers, piping, valves, pumps, cooling towers, and concrete structures). Atmospheric corrosion effects on painted structures, electrical components, and power transmission lines are also discussed. Materials and components which have failed as well as those which have been successful are identified. (Author)

A82-24381 Crude sources and refining trends and their impact on future jet fuel properties. N. R. Sefer and C. A. Moses (Southwest Research Institute, San Antonio, TX). *Society of Automotive Engineers, Aerospace Congress and Exposition, Anaheim, CA, Oct. 5-8, 1981, Paper 811056.* 17 p. 21 refs. Contract No. N00140-80-C-2289.

Jet fuel properties which would influence future availability or cost of JP-5 supplied to the Navy are determined. Significant fuel properties are identified for jet fuel produced from oil shale and coal to develop an alternate test procedure for qualifying new aviation turbine fuels. The availability of JP-5 could be improved by relaxing the freezing point specification to broaden the selection of suitable crudes or broaden the boiling range from a given crude. JP-5 can be made from shale oil with properties that meet current specification, and coal liquids are high in aromatics, low in hydrogen content, and require moderate to high severity hydrogenation. The kerosene fraction will meet JP-5 specifications after most of the aromatics are hydrogenated. D.L.G.

A82-24584 # The rotating heat pipe - Implementation as a uniform-temperature heat source. R. F. Limoges (Eastman Kodak Research Laboratories, Rochester, NY). *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/HT-2.* 6 p. 7 refs. Members, $2.00; nonmembers, $4.00.

A wickless rotating heat pipe, if properly controlled, is a uniform heat source. The data presented are based on work done with 12.7 cm diameter x 76 cm long rotating heat pipes operating between 120 and 140 C. The major areas reviewed are: materials of fabrication, working fluids, sealing, temperature control, heaters, and safety. The optimum rotating heat pipe defined by these studies is fabricated of type 304 stainless steel, uses water as the working fluid, is sealed with welded joints, and utilizes a pressure switch and a fast-response quartz lamp for temperature control. Surface-temperature control of + or - 0.15 C and temperature uniformity within 0.8 C are obtained. Results of experiments designed to study the effects of hydrogen in the enclosed volume of the heat pipe are presented. (Author)

A82-24684 Synthetic, coal-derived fuels. G. R. Hill (Utah, University, Salt Lake City, UT). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 19-23. 8 refs.

Liquefaction and gasification processes for increasing the usage of coal are reviewed, noting their importance as an interim energy source until fusion and solar technologies are suitable for all energy requirements. Coal is ranked from anthracites to hydrogen-free graphites, with bituminous coals containing the lowest water concentrations relative to resource size and availability. Current processes for converting coal to gas or liquid are outlined, including high and low temperature carbonization, hydropyrolysis, liquid-phase hydrogenation, and reactions with oxygen or steam to produce syngas. The Fischer-Tropsch process permits the production of methanol, ethanol, methane, and hydrogen to replace gasoline. Finally, gasification processes are examined in terms of fixed bed, entrained flow, fluidized bed, and integrated high Btu gas processes, all currently performed at precommercial levels of operation. M.S.K.

A82-24691 Pacific Gas and Electric Company - Biomass energy activities. M. J. Blanchet, B. M. Jenkins, J. G. Meyer, P. Maciel, and R. F. Goldstein (Pacific Gas and Electric Co., San Francisco, CA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 99-104. 11 refs.

Pacific Gas and Electric activities in utilizing biomass for the production of gas and electricity are reviewed. Research is centering

on quantifying the available resource, identifying viable conversion systems, determining the economics, and defining limiting factors such as balances between competing alternatives and institutional restraints. A feasibility study for a pyrolysis plant for producing syngas from San Francisco solid waste streams is detailed, along with studies of the forest and crop residues within a 50 mi radius of a subjective plant site. Current projects include a landfill gas recovery system for gas injection into the company lines, a biogas digester at a beef feedlot for processing one dry ton of manure/day, and purchases of cogenerated power from industrial concerns burning wood residue, walnut shells, pelleted wood, garbage, grape pommace, and cotton gin trash. Open ocean kelp farms are noted for future study. M.S.K.

A82-24968 Hydrocracking of coal using molten salts as catalysts. S. Kikkawa, M. Nomura, H. Sakashita, M. Nishimura, and M. Miyake (Osaka University, Osaka, Japan). *(Chemical Society of Japan, Journal,* vol. 923, no. 6, 1980.) *Energy Developments in Japan,* vol. 4, Oct. 1981, p. 183-200. 52 refs. Translation.

Characteristics of the reactions during coal liquefaction and the hydrocracking of coal and coal-related materials using ZnCl2-transition metal chloride or ZnCl2-alkaline metal chloride are discussed. The studies involve development of a molten salt catalyst for hydrocracking heavy residual oils or coals, including hydrocarbons containing many heteroatoms. It was found that ZnCl2 shows higher activity for hydrocracking of anthracene and phenanthrene, and experiments with Yubari coal using the binary metal catalysts ZnCl2-MoCl5 and ZnCl2-CrCl3 are described. The use of molten salts in the desulphurization of heavy residual oils is also explored, specifically for the hydrocracking of benziophene, and the possibility that a coal-like polymer structure containing an oxygen surplus might depolymerize above ternary melts is suggested. M.S.K.

A82-25373 Magmatic gases in well fluids aid the mapping of the flow pattern in a geothermal system. H. Armannsson, G. Gislason, and T. Hauksson (National Energy Authority, Geothermal Div., Reykjavik, Iceland). *Geochimica et Cosmochimica Acta,* vol. 46, Feb. 1982, p. 167-177. 22 refs.

Gas composition and silica concentrations of well fluids are used in conjunction with pressure, temperature and enthalpy data to obtain a model of the drilled part of the Krafla geothermal field (Northeast Iceland). A magma chamber is located at 3-8 km depth under the field. Magmatic gases emanate from the chamber and travel via a channel reaching the surface at the Hveragil eruptive fissure. The composition of the gases is apparently modified on the way, in that sulphur, which presumably is in the form of sulphur dioxide to begin with, is removed, and what remains is in the form of hydrogen sulphide. It is suggested that the major removal mechanism is the deposition of pyrite and pyrrhotite during the passage of the gases through the hydrothermal system. (Author)

A82-25468 Numerical study of wind energy characteristics over heterogeneous terrain - Central Israel case study. M. Segal, R. A. Pielke (Virginia, University, Charlottesville, VA), and Y. Mahrer (Jerusalem, Hebrew University, Jerusalem, Israel). *Boundary-Layer Meteorology,* vol. 22, Mar. 1982, p. 373-392. 35 refs. Research supported by the United States-Israel Binational Science Foundation and NSF.

A numerical mesoscale meteorological model has been applied over the heterogeneous terrain of central Israel in order to study wind energy characteristics of three typical synoptic situations. The supportive nature of this method for observationally oriented wind energy studies has been emphasized. Mesoscale forcing effects on the availability of wind energy and on the exponent, p, in the vertical wind power law are evaluated. (Author)

A82-26015 Relationship of hydrothermal phenomena within the Leinster Granite to crustal fractures delineated from Landsat imagery. P. M. Brück (University College, Cork, Ireland) and P. J. O'Connor (Geological Survey of Ireland, Dublin, Ireland). *Photogrammetria,* vol. 37, Feb. 1982, p. 151-159. 16 refs.

Landsat imagery was combined with existing geologic maps of the Leinster Granite in SE Ireland to develop a model of hydrothermal processes in the area and detect the fracture zones. Observed linears were interpreted as fractures, and satellite imagery allowed the discernment of hydrothermal alteration zones, occurrences of spodume and red-feldspar pegmatites, and explosion breccias. Pb-Zn mineralization sites displayed a spatial association with a transverse fracture system, with galena and sphalerite the main ores in veins with thicknesses ranging from a few meters to a few cm. Hydrothermal processes which may have led to the formation of the Leinster Granite are detailed, along with a suggestion that fractures occuring late in the cooling granite's history formed channels for circulating ground waters. M.S.K.

A82-26177 # Prospecting for wind energy - A field assessment of physical modelling. D. Neal and D. C. Stevenson (Canterbury, University, Christchurch, New Zealand). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 27-30. 5 refs.

The requirements for the modeling of wind characteristics over irregular terrain are examined, and laboratory measurements are discussed. The area considered in the present study is situated on Banks Peninsula in the South Island of New Zealand. The prevailing winds for this region are from the northeast and southwest. A model was constructed using 9 mm thick expanded polystyrene-bead board. This was cut to the shape of the terrain contours obtained from a photographically enlarged map. The final form of construction included the modeling of surface roughness elements on the model. The laboratory measurements were made in a 1.2 m x 1.2 m cross section boundary layer wind tunnel. Measurements of the velocity and turbulence intensity profiles were made with a field data acquisition system including fast response propeller anemometers. G.R.

A82-26004 * Ore deposits in Africa and their relation to the underlying mantle. H.-S. Liu (NASA, Goddard Space Flight Center, Greenbelt, MD). *Modern Geology,* vol. 8, no. 1, 1981, p. 23-36. 70 refs.

African magmatism is largely related to the tensional stress regimes of the crust which are induced by the hotter upwelling mantle rocks. These mantle rocks may provide emanating forces and thermal energy for the upward movements of primary ore bodies with fluid inclusions in the tensional stress regimes of the crust. In this paper, the Goddard Earth Gravity Model is used to calculate a detailed subcrustal stress system exerted by mantle convection under Africa. The resulting system is found to be correlated with the African metallogenic provinces. Recognition of the full spectrum of ore deposits in Africa that may be associated with the hotter upwelling mantle rocks has provided an independent evidence to support the hypothesis of mantle-derived heat source for ore deposits. (Author)

A82-27309 Future fossil fuels - Their utilization and incorporation in modern energy systems (Künftige fossile Brennstoffe - Ihre Nutzung und Einbettung in moderne Energiesysteme). W. Häfele, H. Barnert, and W. Sassin (International Institute for Applied Systems Analysis, Laxenburg, Austria). *DFVLR-Nachrichten,* Mar. 1982, p. 8-19. 8 refs. In German.

Investigations have been conducted regarding the world energy problem, taking into account the next 50 years. It is pointed out that fossil fuels will have to be made available during the considered period. This will be feasible. However, the acquisition of the needed fuels will have to be more and more based on 'unconventional' sources, and the fuels will become expensive. Attention is given to relations between the size of the world population and the energy problem, aspects of energy and utility, liquid hydrocarbons, fossil fuels and the desirability of a zero emission of pollutants, and local and temporal conditions regarding the utilization of fossil fuels. G.R.

A82-27635 # Seasat satellite investigation of the structure of Western Nebraska and its application to the evaluation of geothermal resources. J. Stix (Los Alamos National Laboratory, Los Alamos, NM). In: International Symposium on Remote Sensing of Environment, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 2. Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 735-750. 43 refs.

Seasat synthetic aperture radar (SAR) satellite imagery was used to interpret the structural framework and, indirectly, the geothermal potential of an area in Western Nebraska. Lineaments were mapped

from the imagery and then compared to known structure. It was found that Seasat does record surface manifestations of subtle basement structures, particularly faulting. Furthermore, four areas with geothermal potential were delineated using Seasat and other data. It is stressed that more subsurface geology and geophysical data are needed before a final evaluation of the geothermal potential can be made. Seasat imagery is a useful reconnaissance exploration tool in the interpretation of regional structure within areas of little topographic relief. (Author)

A82-27681 # **Thermal IR detection of submarine gas seepages in the western Istra off-shore area /Yugoslavia/.** M. Knapp and S. Koscec (Industroprojekt, Zagreb, Yugoslavia). In: International Symposium on Remote Sensing of Environment, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 2.
Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 1039-1046.

A82-27693 # **Application of machine processing of visible and thermal data to the study of the geothermal area of Cerro Prieto, Mexico.** A. Jinich, J. L. Farah, M. Garza, C. Velarde, R. Méndez, J. Rosenblueth (Universidad Nacional Autónoma de México, Villa Obregón, Mexico), R. Alvarez, G. García, R. Hernández, and A. López (Comisión Federal de Electricidad, Mexico). In: International Symposium on Remote Sensing of Environment, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 3.
Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 1387-1396. 13 refs. Research supported by the United Nations. UN Project MEX-120-8-004-05-X.

A82-27694 # **Non-parametric classification of abandoned coal mine features using multioriented and ratio transformed Landsat data.** P. W. Mausel, R. C. Howe, and K. Lulla (Indiana State University, Terre Haute, IN). In: International Symposium on Remote Sensing of Environment, 15th, Ann Arbor, MI, May 11-15, 1981, Proceedings. Volume 3. Ann Arbor, MI, Environmental Research Institute of Michigan, 1981, p. 1397-1409. 7 refs.

A82-28130 † **Experience with a variety of studies of earth resources in the Kalmyk ASSR using space imagery (Opyt kompleksnogo izucheniia prirodnykh resursov Kalmytskoi ASSR na osnove kosmicheskoi informatsii).** I. N. El'vartynov and Iu. P. Kienko. *(Vsesoiuznaia Konferentsiia po Problemam Issledovaniia Prirodnykh Resursov Zemli i Mirovogo Okeana, Aviatsionno-Kosmicheskimi Sredstvami, Moscow, USSR, Nov. 1980.) Geodeziia i Aerofotos'emka*, no. 1, 1982, p. 23-26. In Russian.

Various applications of the remote sensing of earth resources in the Kalmyk ASSR are reviewed. These applications include structural mapping, gas and oil exploration, hydrogeology, soil studies, and the mapping of agricultural lands and pastures. B.J.

A82-28391 Temperature effects on the kinetics of the anaerobic digestion of crop residues to methane. E. C. Clausen and A. H. Shah (Tennessee Technological University, Cookeville, TN). *AIChE Symposium Series*, vol. 77, no. 210, 1981, p. 78-85. 15 refs.

Results of a study to determine the optimum temperature ranges for bacterial digestion of crop residues to methane are presented. Four 7 l plexiglass stirred tank reactors were fed sewage sludge and the temperature was varied from 35 to 60 C in 5 deg intervals to gain kinetic data. Feed concentration was tested in the range of 2-10/wt solids. Gas production was lowest at 45 C, and thermophilic digestion did not proceed until above 55 C. An analysis of the rate kinetics for a 200 metric tons/day of cornstalks methane plant was performed, and included the processing steps. Initial costs were $2.7 million for the plant, with over 50% of going for the digesters, and $803,000/yr operating expenses for collection and transport of the residue. Minimum methane costs of $0.10/1000 l of CH4 were reached at 40 C. M.S.K.

N82-16205# Tennessee Technological Univ., Cookeville. Dept. of Chemical Engineering.
CONVERSION OF ORNL WASTE PAPER TO SUGAR USING ACID HYDROLYSIS
E. C. Clausen, A. H. Shah, P. R. Saggurti, W. P. Teichert, and M. E. Harrison 1981 34 p refs Presented at the 7th Ann. Meeting of Am. Inst. of Chem. Eng., New Orleans, Nov. 1981 (Contract W-7405-eng-26)
(DE82-000462; K/SUB-80-7994/1; CONF-811108-5) Avail: NTIS HC A03/MF A01

The Oak Ridge National Laboratory generates large quantities of waste paper that is presently being landfilled. Three processes were investigated in the laboratory for acid hydrolyzing this waste paper to glucose which may be later fermented to ethanol for fuel. Laboratory yields and operating conditions for a high temperature dilute acid process, a concentrated acid process and a process which utilizes waste acid are presented. DOE

N82-16210# Cities Service Research and Development Co., Tulsa, Okla.
FLASH HYDROPYROLYSIS OF WESTERN KENTUCKY NO. 9 BITUMINOUS COAL WITH CATALYST Final Technical Progress Report
31 Mar. 1981 254 p refs
(Contract DE-AC22-79ET-14943)
(DE81-029831; DOE/ET-14943/T1) Avail: NTIS HC A12/MF A01

The effects of selected catalysts on liquefaction of caking and noncaking pulverized coals were investigated. With caking coals, the free fall flash hydropyrolysis reactor operated satisfactorily between temperatures of 1250 to 1550 F and between 900 to 950 F with and without catalyst additions. Noncaking coals could be treated at all ranges of temperatures with or without catalyst additions. Up to two pounds per hour of coal and four pounds per hour of hydrogen were fed into the reactor. Of the catalysts tested, zinc chloride proved most effective, but only at low temperature of about 900 F. At temperatures of 1250 to 1450 F, zinc chloride, as well as other catalysts, proved to be ineffective. At 1400 to 1450 F and 1000 psig with 0.5 seconds solids residence time, about 47 percent of the carbon in caking coals were converted into useful gas and liquid products: 10 percent BTX, 7 percent light oil, 10 percent heavy oil, 27 percent total oil, 12 percent methane, 8 percent ethane, and 20 percent total gas. DOE

N82-16211# Minnick (L. John), Plymouth Meeting, Pa.
DEVELOPMENT OF POTENTIAL USES FOR THE RESIDUE FROM FLUIDIZED-BED-COMBUSTION PROCESSES Quarterly Technical Progress Report, Mar. - May 1981
L. John Minnick 1981 30 p
(Contract DE-AC21-77ET-10415)
(DE81-030157; DOE/ET-10415/T4) Avail: NTIS HC A03/MF A01

Evaluation of the solid wastes from fluidized bed combustion for potential commercial uses is described. Methods by which the material can be safely disposed of should commercial applications be slow in developing were explored. It was shown that spent bed materials from atmospheric fluidized bed (AFB) boilers are potentially useful in a number of commercial applications. AFB residue materials from different sources do contain a substantial component of reactive lime which can, after proper processing, be concentrated and effectively separated from the residue. Spent bed materials also exhibit unusual cementitious properties when used as received or after processing in certain construction related compositions. Evaluation of a number of different sources of AFB residue in the following areas of research was emphasized in the study: (1) characterization of AFB by-product materials; (2) determination of most effective means of beneficiation or separation of materials; (3) laboratory evaluation of the feasibility for use of AFB residue in such applications as a lime substitute, neutralization of acidic trade wastes, flue gas desulfurization, and the stabilization of highly plastic soils; and (4) performance testing of commercial applications involving some cementitious activity. M.D.K.

N82-16213# Washington State Univ., Pullman. Dept. of Mechanical Engineering.
CHARACTERISTICS OF COAL/LIGHT HYDROCARBON SLURRIES IN SPRAY COMBUSTION Semiannual Progress Report, 1 Mar. - 31 Aug. 1981
W. L. Grosshandler, Clayton T. Crowe, and Jacob N. Chung Sep. 1981 23 p refs
(Contract DE-FG22-80PC-30216)
(DE82-000387; DOE/PC-30216/T2) Avail: NTIS HC A02/MF A01

The status of the atomization process, recirculation within the droplet, and the combustion of coal/vaporized fuel in a diffusion burner is discussed. The droplet spray apparatus was

completed and checked out for mixing effectiveness and spray uniformity. Initial runs with pure methanol were completed. Preliminary tests were run with slurries composed of 15% and 30% mixtures of coal in liquid with mean particle sizes of 50 and 150 (Sigma)m. Analysis of the data shows small increases in Sauter mean diameter due to the presence of coal particles. The equations of motion for coal particles translating inside a circulating light hydrocarbon were developed. A computer program has been written to solve for the particle motion numerically. Particle trajectories and general distribution patterns are predicted. The combustion facility was designed and built. Initial testing to assess the stability and flatness of the reaction zone is described. Both a spouted bed and fluidized bed feeder were built to control the mass flow of coal to the burner, and the stability and flow rate of each are being assessed. DOE

N82-16228# Virginia Polytechnic Inst. and State Univ., Blacksburg.
DEVELOPMENT AND APPLICATION OF ANALYTICAL TECHNIQUES TO CHEMISTRY OF DONOR SOLVENT LIQUEFACTION Quarterly Progress Report, Jul. - Sep. 1981
H. C. Dorn and L. T. Taylor Oct. 1981 29 p refs
(Contract DE-AC02-89PC-30041)
(DE82-001076; DOE/PC-30041/T7) Avail: NTIS HC A03/MF A01

The quantitation and speciation of organically bound trace metals in coal liquefaction soluble products presents a real challenge. Quantitation methods have been minimal and have involved single element analysis via atomic absorption spectrometry (AAS) or multi-element analysis via inductively coupled plasma atomic emission spectrometry (ICP-AES) both on acid digested aqueous-based matrices. These methods have not proven highly satisfactory because acid digestion introduces, in some cases, a substantial blank value, requires a great amount of time and in the AAS case provides for only single element determinations with mandatory background correction. Elimination of the sample step preparation coupled with use of ICP-AES seems highly attractive for trace multielement quantitative analysis of coal liquefaction products. We have recently established the capability for metal detection in an organic matrix. DOE

N82-16263# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
POTENTIAL ECONOMIC BENEFITS FROM PROCESS CONTROL OF COAL PREPARATION PLANTS
N. C. Bradley, G. O. Allgood, and J. C. Moyers Oct. 1981 55 p refs
(Contract W-7405-eng-26)
(DE82-000881; ORNL-5738) Avail: NTIS HC A04/MF A01

In practically all US coal preparation plants, the machines and instrumentation and control devices are manually operated to clean the run-of-the-mine coal of mud, rock, and other contaminants that are removed from the earth with the desired product. The result is a large loss of a valuable natural resource. Based on 1978 production figures, 10 million tons of discarded coal could have been saved by on-line measurement and control techniques. Measurement sensors for on-line control of coal cleaning process should be developed because there are no commercial, moderate-cost sensors of medium accuracy (5 to 10 percent) available for such applications. An expenditure of approximately $10 million to develop measurement sensors and process control techniques for coal preparation would be recovered by the conservation of coal. DOE

N82-16264# Department of Agriculture and Fisheries, Silverton (South Africa). Div. of Agricultural Engineering.
SUNFLOWER SEED OIL AS AN EXTENDER FOR DIESEL FUEL IN AGRICULTURAL TRACTORS
J. J. Bruwer, B. vanD Boshoff, F. J. C. Hugo, L. M. duPlessis, J. Fuls, C. Hawkins, A. N. vanderWalt, and A. Engelbrecht 1980 8 p refs Presented at the Symp. of the South African Inst. of Agr. Engr., Silverton, South Africa, 11 Jun. 1980
(DE81-903440; CONF-8006187-1) Avail: NTIS US Sales Only HC A02/MF A01; DOE Depository Libraries

The use of sunflower seeds as an extender for diesel fuels in agricultural tractors is considered. Production requirements to meet the demand are briefly reviewed. Physical and chemical properties of sunflower seed oil are discussed. Tractor engines using diesel fuel or sunflower seed oil were tested as well as engines using various blends of sunflower seed oil with gasoline, diesel fuel, power kerosene, and illuminating kerosene. Results were compared. Engine service life and injection equipment performance are discussed. DOE

N82-16269# California Univ., Livermore. Lawrence Livermore Lab.
LLNL GAS-STIMULATION PROGRAM Semiannual Progress Report, Oct. 1980 - Mar. 1981
M. E. Hanson, G. D. Anderson, and R. J. Shaffer 9 Jun. 1981 52 p refs
(Contract W-7405-eng-48)
(DE82-000802; UCRL-50036-81-1) Avail: NTIS HC A04/MF A01

Preliminary theoretical and experimental analyses of fracture propagation in a nonuniform stress field were performed. Preliminary analyses of fluid flow in apertures were completed. The mechanical properties of some of the core material from Mesaverde sandstones and shales from wells in Wyoming and Colorado were characterized. The feasibility of ultrasonic techniques in measuring in-situ stresses was investigated. Development of a transducer package to test the measurements in a borehole, and techniques to evaluate and interpret measurements are described. The effect of stress on velocity anisotropy was investigated. Geologic studies relating in-situ stresses to geologic structure and examining the effects of pore pressure increases on fracturing in the Green River Basin due to gas generation were performed. DOE

N82-16271# Stearns-Roger Corp., Denver, Colo.
BI-GAS PILOT PLANT OPERATION Quarterly Technical Progress Report, 1 Oct. - 31 Dec. 1980
1980 139 p
(Contract DE-AC01-80ET-14705)
(DE82-000223; DOE/ET-14705/22) Avail: NTIS HC A07/MF A01

At present, the major development effort is concentrated on gasification. As is typical for developmental projects of this magnitude, a large number of operating difficulties have been experienced and overcome since the first operations in August of 1976. Currently the overcoming of operating difficulties still requires some effort. However, most tests are stable and allow the gathering of process design data in the form of validated heat and material balances. These are applied in model simulations of gasifier operation. DOE

N82-16272# Radian Corp., McLean, Va.
VERIFICATION OF THE FOREIGN SYNFUELS INDUSTRIALIZATION EXPERIENCE Final Report
Sep. 1981 88 p refs Prepared jointly with Institute of Gas Technology, Chicago and Research Planning Associates, Paris
(Contract DE-AC01-80RA-50006)
(DE82-000230; DOE/RA-50006/T1; DCN-81-207-001-08) Avail: NTIS HC A05/MF A01

A survey of foreign commercial gasifiers is presented. A master list of commercial gasifiers operating in foreign countries was prepared, listing facilities which are currently operating or have been shut down for less than five years. This list represents the set of sources from which gasifier operation information is potentially available. On site visits to two facilities are reported. DOE

N82-16273# Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil).
PROCEEDINGS OF THE 4TH INTERNATIONAL SYMPOSIUM ON ALCOHOL FUELS TECHNOLOGY, VOLUME 1
1980 483 p refs In PORTUGUESE and ENGLISH Symp. held at Sao Paulo, Brazil, 5-8 Oct. 1980 2 Vol.
(DE81-903753; CONF-801030-Vol-1) Avail: NTIS (US Sales Only) HC A21/MF A01; DOE Depository Libraries

Progress in alcohol and biomass fuels research is reported. Three main areas regarding the alcohol and biomass fuels are covered: production and distribution, utilization, and socio-economical impacts. DOE

N82-16274# Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil).
PROCEEDINGS OF THE 4TH INTERNATIONAL SYMPOSIUM ON ALCOHOL FUELS TECHNOLOGY, VOLUME 2
1980 433 p refs In PORTUGUESE and ENGLISH Symp. held at Sao Paulo, Brazil, 5-8 Oct. 1980 2 Vol.
(DE81-903754; CONF-801030-Vol-2) Avail: NTIS (US Sales Only) HC A19/MF A01; DOE Depository Libraries

An overview of alcohol fuels technology is given. Topics

covered include: diesel engines, fleet tests, lubrication and emission, socioeconomic aspects, and project summaries. DOE

N82-16278# Los Alamos Scientific Lab., N. Mex.
CATALYTIC COAL CONVERSION SUPPORT: USE OF LASER FLASH-PYROLYSIS FOR STRUCTURAL ANALYSIS Progress Report, 1 Oct. - 31 Dec. 1980
C. K. Rofer-Depoorter, comp. Oct. 1981 5 p
(Contract W-7405-eng-36)
(DE82-004221; LA-9033-PR) Avail: NTIS HC A02/MF A01

A coal processing apparatus that will allow online sampling of gases generated during coal processing is operational. Improvements were made in the lasers and the GC/MS. Lignin impregnated with $ZnCl_2$, coal extracted with liquid CO_2, and isolated resinite and fusinite were pyrolyzed. A thermal model of the pyrolysis is being developed. DOE

N82-16277# Sandia Labs., Albuquerque, N. Mex.
REVERSIBILITY OF COAL LIQUEFACTION
M. G. Thomas, T. C. Bickel, and D. E. Trudell 1981 16 p refs Presented at the Ann. Meeting of the Inst. of Chem. Engr., New Orleans, 8 Nov. 1981
(Contract DE-AC04-76DP-00789)
(DE81-027804; SAND-81-0211C; CONF-811108-3) Avail: NTIS HC A02/MF A01

Dissolution of coal was shown to be affected by the amount of preasphaltenes formed which is related to the repolymerization of preasphaltenes when solvent quantity and/or quality are limited. Repolymerized preasphaltenes are shown to be reactive suggesting that a process reversibility exists for this first step of the liquefaction sequence and explaining limited solvation for early stage liquefaction. This reversibility is direct evidence that gas formation is a non-essential side reaction that is a consequence of time at temperature, not the interconversion of coal derived materials. Addition of asphaltenes, increases the amount of oil produced. This increase is accompanied by some polymerization of the asphaltenes. Process reversibility is thus observed for both the primary and secondary step of liquefaction. The effect of increases in hydrogen availability by chemical spikes and/or H-donor molecules was shown to partially compensate for the solvent deficiencies observed in the later stages of processing. M.D.K.

N82-16279# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
SMALL-SCALE FUEL-ALCOHOL PLANT. VOLUME 2: DETAILED EQUIPMENT INFORMATION Design Report
Aug. 1981 206 p
(Contract DE-AC07-76ID-01570)
(DE82-001037; DOE/TIC-2001037-Vol-2; ID-10102-Vol-2) Avail: NTIS HC A10/MF A01

Technical information about the equipment used in the Small Scale Fuel Alcohol Plant (SSFAP) is reported. Details are provided in the form of data sheets for off-the-shelf mechanical equipment and instrumentation. A specification is also included for a microprocessor. Complete drawings are included for mechanical hardware specifically designed for this plant. The information is arranged with all instrument and equipment data sheets grouped by the type of equipment. Vendor listings are provided for each type of equipment required. The design in this report represents the design after startup testing and some short periods of operation but before continuous production began. It is expected that a person or firm desiring to build a similar plant would hire a consultant or architect-engineering firm to modify this design to fit the specific application and site. DOE

N82-16281# Gilbert (Glen A.) and Associates, Inc., Oak Ridge, Tenn.
FOREIGN COAL-LIQUEFACTION-TECHNOLOGY SURVEY AND ASSESSMENT
T. D. Pay and S. S. Patel Oct. 1981 341 p refs Prepared for ORNL
(Contract W-7405-eng-26)
(DE82-000555; ORNL/Sub-79/13837/6) Avail: NTIS HC A15/MF A01

The Foreign Coal Liquefaction Technology survey and Assessment is part of the International Energy Technology Assessment effort. Six countries were chosen. They are Australia, the Federal Republic of Germany (FRG), Japan, New Zealand, South Africa and the United Kingdom. These countries have active coal liquefaction programs, are using or developing technologies that could be used in the US and/or involved with US coal liquefaction programs. The resources that each has and the policies that have been adopted by their governments are presented. Although each of these countries has numerous programs underway or planned, the amount of information available on each program varies. Brief descriptions of the programs are given in the first chapter; the second chapter deals only with those liquefaction projects and gasifiers associated with direct liquefaction for which an adequate amount of reference material could be found. In the third chapter, critical areas common to all or many liquefaction systems are described. DOE

N82-16282# Utah Univ., Salt Lake City. Dept. of Mining, Metallurgical and Fuels Engineering.
CONCEPTS OF FUNDAMENTAL PROCESSES RELATED TO GASIFICATION OF COAL Quarterly Progress Report, Jan. - Mar. 1981
W. H. Wiser Sep. 1981 3 p
(Contract DE-AM03-77SF-01484)
(DE82-000763; DOE/SF-01484/T2) Avail: NTIS HC A02/MF A01

The primary objective of the research on single stage catalytic coal gasification is to optimize the process variables and catalyst systems to maximize yields. The 200 mesh coal will be slurried in a hydrogen donor solvent, tetralin, in a ratio of 2 parts solvent to 1 part coal by weight, and initially a sulfided Ni-W/SiO_2-Al_2O_3 catalyst will be used. All of the required equipment arrived and the system has undergone pressure testing and some minor redesign. The objective of the project on single stage coal gasification to high Btu gas is to investigate the potential for obtaining high methane yields by direct catalytic hydrogenation of coal in a single stage with a maximum temperature of 5500 C. The work completed so far has included a thermodynamic feasibility study which involved investigating the effect of various parameters, temperature, pressure, and steam percent in hydrogen feed. Fifteen experimental runs have been completed. DOE

N82-16283# Pittsburg Univ., Pa. Dept. of Chemical and Petroleum Engineering.
EXPERIMENTAL STUDY OF THE MULTIPLE STEADY STATES IN AN ADIABATIC COAL-LIQUEFACTION REACTOR Annual Report, 1 Sep. 1980 - 31 Aug. 1981
Y. T. Shah and P. C. Singh Sep. 1981 75 p refs
(Contract DE-FG22-80PC-30243)
(DE82-000770; DOE/PC-30243/T2) Avail: NTIS HC A04/MF A01

The purpose of the proposed study is to investigate experimentally the thermal behavior of coal liquefaction reactors. Stability of the steady state is specifically planned to be investigated in the adiabatic continuous stirred tank reactor used in the A-1 unit of the Gulf Research Center. When a reactor has more than one possible temperature for steady state operation, large temperature excursions may result from a small perturbation. An efficient control of temperature is then needed to avoid this type of run away of the reactor. In case of coal liquefaction reactors, below 4500 C no substantial reaction is observed, while above 4650 C there is every possibility of coking of the reactor. The operating range is thus very narrow and it is undesirable to have temperature excursions. A theoretical investigation of these reactors has shown multiple steady states in pilot plant operations. Industrial coal liquefaction reactors operate very close to an adiabatic mode. DOE

N82-16284# Brigham Young Univ., Provo, Utah.
INVESTIGATION OF SULFUR-TOLERANT CATALYSTS FOR SELECTIVE SYNTHESIS OF HYDROCARBON LIQUIDS FROM COAL-DERIVED GASES Quarterly Technical Progress Report, 19 Mar. - 18 Jun. 1981
C. H. Bartholomew 15 Jul. 1981 32 p refs
(Contract DE-AC01-79ET-14809)
(DE82-000274; DOE/ET-14809/7-7) Avail: NTIS HC A03/MF A01

During the seventh quarter, preparation of the proposed boride-promoted catalysts was completed. An aqueous solution technique was found to improve the preparation of the supported metal boride catalysts. Characterization of 3 and 15% cobalt catalysts by O2 titration and H2 and CO chemisorptions showed dispersions to be near 7.3%. Reduction was optimum after 36 hours at 623 K. Activity/selectivity measurements showed Co/SiO_2 catalysts to be more active by an order of magnitude than corresponding Fe/SiO_2 catalysts in Fischer-Tropsch synthesis. The unsupported cobalt boride was found to be less

active, though it produced a higher molecular weight product than similar silica-supported cobalt catalysts. H2S deactivation equipment construction and calibration has been completed and preliminary tests performed. DOE

N82-16283# Washington Univ., St. Louis, Mo. Dept. of Chemical Engineering.
DYNAMIC BEHAVIOR OF MOVING-BED COAL-GASIFICATION REACTORS Annual Report, 1 Sep. 1980 - 31 Aug. 1981
B. Joseph Sep. 1981 82 p refs
(Contract DE-FG22-80PC-30219)
(DE82-000595; DOE/PC-30219/T1) Avail: NTIS HC A05/MF A01

A rigorous dynamic model of the two moving-bed coal gasifier was developed. The resulting coupled nonlinear partial differential equations were solved numerically using a digital computer. The model was validated through comparison with steady state pilot plant operating data and with results of existing steady state models. A number of transient studies were conducted using the dynamic mode including response to variations in coal feed rate, steam rate and oxygen feed rate. The internal solid and gas temperature profiles as well as the product gas composition were tracked as a function of time. The stability of the gasifier under various types of feedback control strategies were studied. The results are given in the form of response curves to typical input disturbances. DOE

N82-16286# Southwest Research Inst., San Antonio, Tex. Dept. of Engine and Vehicle Research.
ALTERNATE FUELS IN MEDIUM-SPEED DIESEL ENGINES: OFF-SPECIFICATION DIESEL FUELS, SIMULATED COAL-DERIVED FUEL AND METHANOL
Q. A. Baker Jan. 1981 155 p refs
(Contract DOE-EM-78-C-4266)
(PB81-242562; FRA/ORD-80/40.I; Rept-1) Avail: NTIS HC A08/MF A01 CSCL 21D

The first year of research activity of a multi-year research, development, and demonstration effort to investigate the use of alternate fuels in medium-speed diesel engines is described. Tests were performed on a laboratory two cylinder medium speed diesel engine in an attempt to define its ability to operate on alternate fuels and to define the performance and emission characteristics of the engine under such operation. GRA

N82-16375# California Univ., Livermore. Lawrence Livermore Lab.
EFFECTS OF GAS-FLOW PATTERN ON CAVITY SHAPE
John R. Creighton 22 Jul. 1981 16 p refs Presented at the 7th Ann. Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 7-11 Sep. 1981
(Contract W-7405-eng-48)
(DE82-000347; UCRL-85907; CONF-810923-10) Avail: NTIS HC A02/MF A01

The effects of different gas flow patterns on the cavity shape in laboratory scale coal block experiments are shown. The burning of pure carbon is modeled. The rate of removal of carbon from the cavity wall is shown to depend on the local rate of oxygen transport to the wall. A numerical model which assumes plug flow in the cavity with a laminar boundary layer gives cavities shaped like an exponential horn, with the largest radius next to the inlet. The downstream shape is in reasonable agreement with experiment. When cavity flow is calculated using the full Navier-Stokes equations the flow near the inlet resembles an expanding jet surrounded by a torroidal vortex. The maximum rate of oxygen transport to the wall occurs where the jet strikes the converging cavity wall some distance downstream. The reduced oxygen transport near the inlet causes the upstream portion of the cavity to be rounded. The downstream portion of the cavity is similar to that with plug flow. DOE

N82-16381# Los Alamos Scientific Lab., N. Mex.
COAL-GASIFICATION INSTRUMENTATION PROGRAM (PR 11734) Quarterly Progress Report, 1 Jul. - 30 Sep. 1981
1 Oct. 1981 38 p refs
(Contract W-7405-eng-36)
(DE82-001153; DOE/TIC-2001153) Avail: NTIS HC A03/MF A01

Methods of measuring alkali metals, NO, NH3 and H2S in coal gasification products are being studied using laser-induced breakdown spectroscopy, coherent anti-Stokes Raman spectroscopy and infrared spectroscopy. Detection limits under various conditions and comparison with gas chromatography results are presented. DOE

N82-16484*# Ketron, Inc., Wayne, Pa.
UNDERGROUND COAL MINING SECTION DATA Final Report
Charles P. Gabrill and Jack T. Urie 24 Sep. 1981 151 p refs Prepared for JPL
(NASA-CR-168393; JPL-9950-901) Avail: NTIS HC A08/MF A01 CSCL 08L

A set of tables which display the allocation of time for ten personnel and eight pieces of underground coal mining equipment to ten function categories is provided. Data from 125 full shift time studies contained in the KETRON database was utilized as the primary source data. The KETRON activity and delay codes were mapped onto JPL equipment, personnel and function categories. Computer processing was then performed to aggregate the shift level data and generate the matrices. Additional, documented time study data were analyzed and used to supplement the KETRON database. The source data including the number of shifts are described. Specific parameters of the mines from which there data were extracted are presented. The result of the data processing including the required JPL matrices is presented. A brief comparison with a time study analysis of continuous mining systems is presented. The procedures used for processing the source data are described. N.W.

N82-16482# Department of Energy, Morgantown, W. Va. Energy Technology Center.
PRELIMINARY RESOURCE ASSESSMENT OF COALBED METHANE IN THE UNITED STATES
Apr. 1981 30 p refs
(DE82-001356; DOE/METC/SP-186) Avail: NTIS HC A03/MF A01

Preliminary results of the DOE Methane Recovery from Coalbeds Project reveal that many of the coal regions in the United States have significant volumes of coalbed methane. These results show that 46 cooperative wells drilled to date have helped to update the estimates of methane in the various coal regions. The most promising coal region is in the Green River Basin where preliminary estimates show that the methane potential may be over 23 trillion cubic feet. Another area of considerable interest is in the Arkoma Basin where the methane content of coal samples ranged from 200 to 400 cubic feet per ton (cf/ton) of coal. The methane estimate in this basin is between 1.8 to 3.6 trillion cubic feet. The Piceance Creek coal region is an area presently generating considerable interest and industry activity. The methane content of the coal samples extracted from this basin averaged over 100 cf/ton. The Northern Appalachian region also shows considerable promise. DOE

N82-16484# New Mexico State Univ., Las Cruces. Dept. of Chemical Engineering.
ENHANCED OIL RECOVERY BY CO2 FOAM FLOODING Quarterly Report, 1 Jul. - 30 Sep. 1981
S. Holbrook, Murty Kuntamukkula, John T. Patton, and Ken Spence (Bartlesville Energy Technology Center, Okla.) 30 Sep. 1981 6 p
(Contract DE-AS21-78ET-12083)
(DE82-000949; DOE/MC-12083/14) Avail: NTIS HC A02/MF A01

Progress reports are presented for the following tasks: apparatus design and construction; foam generation and static stability; dynamic foam stability; foam rheology; oil displacement efficiency; mathematical modeling; and final reports. The past quarter was productive with the major effort directed toward bringing the project to a successful completion. All project objectives were met and the results are encouraging with respect to potential commercial applications. DOE

N82-16485# Rensselaer Polytechnic Inst., Troy, N. Y. Office of Contracts and Grants.
EFFECTS OF POROSITY TYPE, PORE GEOMETRY, AND DIAGENETIC HISTORY ON TERTIARY RECOVERY OF PETROLEUM FROM CARBONATE RESERVOIRS Final Report, 1 Jul. 1979 - 30 Nov. 1980
G. M. Friedman, Kenneth Furyls, and Anne Reeckmann Sep. 1981 228 p refs
(Contract DE-AC21-79MC-11580)
(DE82-000896; DOE/MC-11580/5) Avail: NTIS

HC A11/MF A01

The mechanisms controlling porosity in Red River formation (Upper Ordovician) carbonate reservoirs, were studied in order to determine what types of pore systems result from a given set of depositional and diagenetic conditions. The Red River Formation of Montana is a major oil-producing reservoir in the area and Cabin Creek Field is a good candidate to undergo tertiary recovery in the future. The stratigraphy, distribution of lithofacies, despositional environments, and diagenesis of the study area are discussed. The various types of porosity present, their origin, how they are distributed throughout the upper Red River reservoirs, and how they relate to depositional environment are discussed. Size and shape of pores and pore throats are in terms of statistical measures from capillary-pressure curves, and by interpretation of scanning-electron micrographs of resin-pore casts. Petrophysical relationships, diagenetic controls on the development and geometry of pore systems, and the role of pore geometry in the determination of carbonate reservior characteristics are also addressed. DOE

N82-16472# Terra Tek, Inc., Salt Lake City, Utah. Drilling Research Lab.

SMALL BUSINESS INNOVATION RESEARCH: OIL RECOVERY ENHANCEMENT BY ACOUSTIC MEANS Final Report

Ahmed S. Abou-Sayed, George J. Dvorak, Sidney J. Green, Arion H. Jones, Richard Lingle, and Joseph B. Walsh Feb. 1981 47 p refs

(Grant NSF DAR-79-17712)

(PB81-243842; NSF/IST-81001) Avail: NTIS HC A03/MF A01 CSCL 08I

The effect of a stress wave pulse on a porous saturated rock was studied. Three different situations were analyzed: The presence of a linear viscoelastic (Newtonian) fluid in the pore space; the presence of a nonlinear (non-Newtonian) fluid in the pore space without a pore filled pressure gradient, i.e., fluid flow; and the presence of a nonlinear (non-Newtonian) fluid in the pore space with a pore fluid pressure gradient, i.e., fluid flow. It was found that there can be no pumping action with a periodic stress wave in a system containing a linear, Newtonian fluid for stress pulses in the low frequency range. Pumping will occur for frequencies above about 1,000 cycles per second for the material and pore spacing considered in the study typical of some rocks. GRA

N82-16501# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

CASE STUDIES OF LOW-TO-MODERATE TEMPE ATURE HYDROTHERMAL ENERGY DEVELOPMENT

Oct. 1981 126 p refs Prepared in cooperation with California Univ., Lawrence Berkeley Lab.

(Contract DE-AC07-76ID-01570)

(DE82-000883; IDO-10098) Avail: NTIS HC A07/MF A01

Six development projects that use low to moderate temperature geothermal resources were examined. The projects illustrate many facets of hydrothermal development. The history of this development, its exploratory methods, and its resource definition, are described and address legal, environmental, and institutional constraints. DOE

N82-16517# Foster Wheeler Corp., Livingston, N.J.

INDUSTRIAL STEAM SUPPLY SYSTEM CHARACTERISTICS PROGRAM. PHASE 2: LOW- AND MEDIUM-Btu GAS-FIRED BOILERS WITH ASSOCIATED GASIFICATION PLANTS Final Report

Sep. 1981 292 p refs Prepared for ORNL

(Contract W-7405-eng-26)

(DE82-000535; ORNL/Sub-80/13847/2; FWDC-9-41-8903) Avail: NTIS HC A13/MF A01

For each system, two coal sources were considered, an Eastern high-sulfur bituminous coal and a Western low-sulfur subbituminous coal. Eight different systems were studied and conceptual cost estimates prepared for each of them. Scaling factors were developed over a range of plant sizes; cost ratios were prepared for multiple unit systems; and cost sensitivities vs degree of sulfur removal were developd for each of the on-site gasification systems. T.M.

N82-16519# Booz-Allen and Hamilton, Inc., Bethesda, Md. Energy Analysis and Environment Div.

ASSESSMENT OF EMERGING ENERGY SOURCES Summary Report

Sep. 1981 43 p refs

(DE82-900318; EPRI-EA-2023-SY) Avail: NTIS HC A03/MF A01

The results of a broad review and analysis of the commercialization potential for eight emerging sources of energy are summarized. Tight gas sands, heavy oil, methane from geopressured aquifers, oil shale, enhanced oil recovery, advanced coal mining technologies, and underground coal gasification are discussed. Each source of energy or technology was evaluated with respect to six factors affecting commercialization: size and characteristics of resource; technical and economic performance; relevant energy market growth rates; logistical considerations; development lead times; and regulatory and institutional factors. The evaluation was based on a review of existing literature, extensive interviews with industry expert, and an overall assessment of the degree to which these factors would constrain commercial development. In addition, estimates were made of supply potential from each emerging energy. DOE

N82-16529# Institute of Gas Technology, Chicago, Ill.

DEVELOPMENT OF HYDROCONVERSION OF BIOMASS TO SYNETHETIC FUELS. PROJECT 61042 TECHNICAL REPORT Technical Progress Report, 16 May - 30 Sep. 1980

Dec. 1980 57 p refs

(Contract DE-AC02-80CS-83004)

(DE82-000874; DOE/CS-83004/1) Avail: NTIS HC A04/MF A01

The objective of this program is to develop the hydroconversion (in-situ production and addition of hydrogen to carbonaceous species) of biomass (forest and crop residues) to produce substitute natural gas. The program will also include experiments to investigate the production of hydrocarbon liquids from biomass. Progress made during the first reporting period is reported. A list of recent biomass survey and availability literature was compiled; samples of wood materials were obtained for characterization, handling, and bench-scale testing. Standard chemical and physical tests for biomass materials were identified for use in characterizing each material and its char in the program. The initial analysis and testing began with a sample of Douglas fir hog fuel. Bench-scale hydrodevolatilization and char gasification tests were performed. Experiments with maple hardwood chips are in progress. A detailed report describing the process development unit design was submitted. DOE

N82-16539# RMR Associates, Palo Alto, Calif.

COGENERATION POTENTIAL: ENHANCED OIL RECOVERY Final Report

R. M. Rodden and J. L. Boyen Aug. 1981 69 p refs Sponsored by EPRI

(EPRI Proj. 1276-7)

(DE81-904202; EPRI-EM-1996) Avail: NTIS HC A04/MF A01

The purpose of this project was to perform preliminary evaluation of the potential in the United States for generating electric power in connection with producing steam for the enhanced recovery of oil. The analysis identified the size and location of the heavy oil resource base and developed estimates of oil recovery potential. Using these data, estimates were made of electric power capacity that could result if cogeneration were used to supply the necessary steam for thermal recovery. Incentives and obstacles to the use of cogeneration for thermally enhanced oil recovery are identified and discussed. The attitudes of the utilities companies and the petroleum producers toward the possible use of cogeneration for thermal oil recovery are also identified and discussed. The report presents preliminary design information on cogeneration systems that would be suitable for thermally enhanced recovery. DOE

N82-16545# Economic Research Service, Washington, D. C. Natural Resource Economics Div.

COAL DEVELOPMENT IN RURAL AMERICA: THE RESOURCES AT RISK

Wallace McMartin, Virgil Whetzel, and Paul R. Myers Aug. 1981 92 p refs

(PB81-243313; RDRR-29) Avail: NTIS HC A05/MF A01 CSCL 10A

The resource base in rural America that will be affected by future mining, transportation, and use of coal is described. These resources are land, water, vegetation, people, and farm or ranch enterprises. Author

N82-16557# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
THERMODYNAMIC DATA FOR FLUE-GAS DESULFURIZATION PROCESSES
Leo Brewer Aug. 1981 56 p refs Presented at the FGD Symp., Morgantown, W. Va., 6-7 Nov. 1980
(Contract W-7405-eng-48)
(DE81-030545; LBL-11758; CONF-801176-1) Avail: NTIS HC A04/MF A01

Thermodynamic and kinetic data for the various materials that might be used in desulfurization processes resulting from coal and oil combustion are presented. Examination of the available thermodynamic data for sulfur compounds indicates serious uncertainties and a complete review is planned to provide the best set of internally consistent values obtainable from the literature and from current experiments. Although the main emphasis will be on information needed for aqueous limestone or lime slurry treatment, the data could also be used for other processes covering a wider temperature range. Thus it is planned to provide the data, when possible, for the range from room temperature to at least 1000K. The present compilation covers most of the materials that might play a role in SO2 extraction processes and for which data were found. Supplements will be issued as data are obtained for additional substances of interest. DOE

N82-16560# Exxon Research and Engineering Co., Linden, N.J. Contract Research Div.
FORMATION OF NO SUB x AND OTHER PRODUCTS FROM CHEMICALLY BOUND NITROGEN IN COAL COMBUSTION Final Report
David W. Blair and J. O. L. Wendt Jun. 1981 298 p refs
(Contract DE-AC21-77ET-11314)
(DE81-028536; DOE/ET-11314/T1) Avail: NTIS HC A13/MF A01

The purpose of this project was to advance the fundamental understanding of fuel nitrogen conversion in coal combustion towards the ultimate end of providing for the rational design of coal combustors with acceptably low NO/sub x/ outputs. In pursuit of this objective the program attacked the problem both experimentally and theoretically. Experimental work concentrated upon the pyrolysis stage of coal combustion. It investigated the loss of mass, nitrogen, and sulfur from the solid phase and the distribution of important chemical species in the pyrolyzate under simulated combustion heating conditions. Experimentally variables included temperature, heating rate, atmospheric reactivity, thermal history (preheating, reheating) and coal type. These experiments were performed upon twenty coals of widely varying types, two chars, and one petroleum coke. The results of the work suggest that the conditions of coal nitrogen conversion can be controlled by adjusting external variables. DOE

N82-16673# Pacific Northwest Lab., Richland, Wash.
THE WIND CHARACTERISTICS PROGRAM ELEMENT Annual Report, Oct. 1979 - Sep. 1980
L. L. Wendell, W. R. Barchet, J. R. Connell, A. H. Miller, W. T. Pennell, and D. S. Renne Sep. 1981 200 p refs
(Contract DE-AC06-76RL-01830)
(DE82-004876; PNL-3876) Avail: NTIS HC A09/MF A01

The progress accomplished directly by the Pacific Northwest Laboratory (PNL) and by subcontractors funded directly by DOE or through PNL is reported. To expedite the management of the activities to produce the required information, the WCPE was divided into three program areas: wind energy prospecting, support for design and operations, and site evaluation. Accomplishments in each of these program areas provide a highlight of WCPE activities. DOE

N82-16918# Sandia Labs., Albuquerque, N. Mex.
EFFECT OF THERMOMECHANICAL PROPERTIES ON INITIAL CAVITY GROWTH
R. E. Glass 1981 21 p refs Presented at the 7th Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 8 Sep. 1981
(Contract DE-AC04-76DP-00789)
(DE81-030839; SAND-81-1941C; CONF-810923-9) Avail: NTIS HC A02/MF A01

Recent field and laboratory studies in UCG have indicated that the thermomechanical properties of coals may be the controlling parameters in determining initial cavity growth. To examine this possibility laboratory and modeling efforts are being directed at determining these properties and incorporating them in a cavity growth model. The results of the work emphasize the critical role that anisotropic strengths play in determining the shape of the cavity. DOE

N82-17286 North Carolina Univ. at Chapel Hill.
CORRELATION AND INTERFEROMETRIC DATA ANALYSIS APPLIED TO GAS CHROMATOGRAPHY FOURIER TRANSFORM INFRARED SPECTROSCOPY Ph.D. Thesis
Richard Claburn Wieboldt 1981 140 p
Avail: Univ. Microfilms Order No. 8125636

Gas chromatography Fourier transform infrared spectroscopy provides the chemist with the ability to separate and identify, simultaneously, mixture components. Effective analysis of data generated requires algorithms that rapidly identify portions of data which contain useful information and provide assistance in identification. The development of such algorithms and their application to the analysis of shale oil mixtures is reported. The optical design for a gas chromatograph FTIR interface is described along with its limitations. A correlation technique which allows the FTIR to be used as a specific detector for the gas chromatograph is also discussed. The use of fast Fourier transform subroutines is described in detail as part of the method for generating the synthetic interferograms. With this approach, the key absorption features for nine functional groups were determined. Dissert Abstr.

N82-17314# Amoco Oil Co., Naperville, Ill. Research and Development Dept.
COAL-LIQUEFACTION CATALYST DEVELOPMENT Quarterly Progress Report, 1 Oct. - 30 Dec. 1980
J. A. Mahoney and J. J. Helstrom Mar. 1981 54 p
(Contract DE-AC22-79ET-14803)
(DE82-000137; DOE/ET-14803/T6; QPR-5) Avail: NTIS HC A04/MF A01

The materials initially deposited onto the catalyst were determined. A large amount of coke with an H/C ratio of 1.13 was deposited. The deposition of trace metals was also quite severe, and high levels of iron and titanium were found. At the same time there was a substantial corresponding reduction in surface area and pore volume. The sulfur is already at the usual level found in used catalysts, reflecting the condition that the major portion of the sulfur is probably combined with the sulfided cobalt and molybdenum; it would appear that only a minor part of the sulfur is combined with the coke. These results might indicate that, although a considerable amount of coke has been deposited, it is quite permeable in the early part of the experiment and becomes less permeable with time. DOE

N82-17315# Utah Univ., Salt Lake City. Dept. of Mining and Fuels Engineering.
CHEMISTRY AND CATALYSIS OF COAL LIQUEFACTION: CATALYTIC AND THERMAL UPGRADING OF COAL LIQUID AND HYDROGENATION OF CO TO PRODUCE FUELS Quarterly Progress Report, Apr. - Jun. 1981
Wendell H. Wiser Aug. 1981 56 p refs
(Contract DE-AC22-79ET-14700)
(DE82-000762; DOE/ET-14700/7) Avail: NTIS HC A04/MF A01

A technique was developed to measure active sites on a sulfided CoMo/Al2O3 catalyst by gravimetric measurements of O2 chemisorbed at -780 C in a dilute air/He stream. It was found that neither polarity nor concentration affected effective diffusivity of solutes in a porous catalyst support, which confirmed earlier results that surface diffusion is not operative in these systems, and that the dominant factor which determines diffusivity appears to be a drag coefficient. Reports of the following task groups with summaries are presented: chemical-catalytic studies; carbon-13 NMR investigation of CDL and coal; catalysis and mechanism of coal liquefaction; fundamental chemistry and mechanism of pyrolysis of bituminous coal; catalytic hydrogenation of CD liquids and related polycyclic aromatic hydrocarbons; denitrogenation and deoxygenation of CD liquids and related N- and O-compounds; and catalytic cracking of hydrogenated CD liquids. DOE

N82-17317# Argonne National Lab., Ill. Chemical Engineering Div.
SAMPLING AND ANALYSIS OF HYDROCARBONS IN COMBUSTION GASES Quarterly Report, Jan. - Mar. 1981
I. Johnson, D. C. Fee, and K. M. Myles Aug. 1981 24 p refs
(Contract W-31-109-eng-38)
(DE82-002511; ANL-CEN-FE-81-7) Avail: NTIS HC A02/MF A01

Real-time on-line methods for the chemical analysis of ultratrace levels of polycyclic organic compounds in the flue gases from fluidized-bed coal combustors were evaluated. The technique that currently shows the most promise for on-line monitoring is atmospheric-pressure-ionization triple quadrupole mass spectrometry. DOE

N82-17339# Notre Dame Univ., Ind. Dept. of Metallurgical Engineering and Materials Science.
MICROSTRUCTURAL EFFECTS IN ABRASIVE WEAR Quarterly Progress Report, Dec. 1980 - 1 Jun. 1981
T. H. Kosel, M. C. Rao, H. R. Shetty, M. T. Fernandes, and N. F. Fiore 29 Oct. 1981 71 p refs
(Contract DE-AS02-77ET-10460)
(DE82-003653; DOE/ET-10460/16/17) Avail: NTIS HC A04/MF A01

This report describes research aimed at establishing quantitative relationships between microstructure and wear resistance of highly alloyed materials, including high-Cr white irons and experimental Co-base and Ni-base powder metallurgy (PM) alloys now used or potentially to be used in coal mining, handling, and gasification. The specific types of wear under study are low-stress abrasion and gouging wear encountered in mining, coal conversion, and transfer applications. During this period, work was concentrated on analysis of results. The many detailed observations obtained in the work on scratch test simulations of abrasive wear mechanisms have been summarized in drafts of three papers. The first, A Study of Abrasive Wear Mechanisms Using Diamond and Alumina Scratch Tests, is included as an appendix to this report and is being submitted for publication. Revision of the other papers is in progress. DOE

N82-17391# Buderus A.G., Wetzlar (West Germany).
PROMOTION OF UTILIZING PRIMARY ENERGY AND REDUCTION OF EMISSION WITH GRATE-EQUIPPED HEAT GENERATORS FIRED COMPLETELY AUTOMATIC WITH SOLID FUELS Final Report, Dec. 1980
Eberhard Nickel and Guenter Hoefeld Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 181 p refs Sponsored by Bundesministerium fuer Forschung un Technologie
(BMFT-FB-T-81-222; ISSN-0340-7608) Avail: NTIS HC A09/MF A01

The development of two automatic boiler systems for the combustion of anthracite and crushed coke is described. The systems differ in their output range and in the type of grate used. Both systems allow the substitution of coke or coal for fuel oil. Maintenance facilities and boiler efficiency are considered. J.D.H.

N82-17395# Kimball (L. Robert) and Associates, Ebensburg, Pa.
BRIQUETTING OF FINE COAL USING A SODIUM CHLORIDE BINDER Final Report
E. Y. Crossmore, Jr., R. J. Kimball, and S. M. Kimball Oct. 1981 41 p refs
(Contract DE-AC01-79ET-14303)
(DE82-000632; DOE/ET-14303/T1) Avail: NTIS HC A03/MF A01

The economic and technological feasibility of producing dense, weather resistant briquettes from fine particulate bituminous coal was demonstrated. The binder consists of a sodium chloride dendritic crystalline matrix. The proclivity for liberation of pyritic sulfur and ash from fine coal particles for precombustion Deep Cleaning was investigated, in efforts to comply with clean air standards. Process technology as to coal beneficiation produces fine sized particles and handling the material after treatment is problematic. Reconstitution of this fine particulate was studied. Briquettes were produced which are equivalent to lump natural coal. Their heat value is greater as they contain less moisture and subjective burn tests for the product show a fouling index increase range. DOE

N82-17396# Spectron Development Labs., Inc., Costa Mesa, Calif.
EXPERIMENTAL INVESTIGATION OF SYNFUEL SPRAY CHARACTERISTICS AND COMBUSTION DYNAMICS Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981
Jul. 1981 80 p refs
(Contract DE-AC22-80PC-30299)
(DE82-000412; DOE/PC-30299/T4; SDL-81-2176-180) Avail: NTIS HC A05/MF A01

Fundamental information on the characteristics and behavior of both petroleum based oils and synthetic fuels in spray combustion was sought by applying advanced optical diagnostic techniques to study the processes of fuel injection and atomization, droplet ignition, and spray combustion. The program was conducted in three phases: cold flow spray experiments; monodispersed droplet combustion; and spray combustion experiments. Parametric testing of all candidate injectors with number 2 fuel oil was completed. Efforts on spray characterization study were limited to completion of the final design of the traverse system for the droplet sizing interferometry (DSI). Detailed design of the monodisperse droplet combustion was completed. M.D.K.

N82-17397# American Farmers' Marketing Cooperative, Mayfield, Ky. Ethanol Div.
FEASIBILITY STUDY FOR ALTERNATIVE FUELS PRODUCTION: BIOMASS TECHNOLOGY, VOLUME 2: ADDENDUM, ECONOMIC AND FINANCIAL ANALYSIS
15 Dec. 1980 198 p refs
(Contract DE-FG07-80RA-50333)
(DE82-000030; DOE/RA-50333/T1-Vol-2) Avail: NTIS HC A9/MF A01

The feasibility of constructing and operating a motor-fuel ethanol plant is investigated. Detailed results are presented. The results of site surveys and area surveys are presented. Site preparation plans are outlined. Energy and material balances and equipment requirements are established as a part of the overall procedure to validate costs. Process flow sheets are included. Detailed diagrams of the plant design are also included. The management plan for the operation of the plant is discussed. DOE

N82-17398# Fluor Engineers and Constructors, Inc., Irvine, Calif.
COAL-TO-METHANOL: AN ENGINEERING EVALUATION OF TEXACO GASIFICATION AND ICI METHANOL-SYNTHESIS ROUTE Final Report
P. A. Buckingham, D. D. Cobb, A. A. Leavitt, and W. G. Snyder Aug. 1981 126 p refs
(DE81-904235; EPRI-AP-1962) Avail: NTIS HC A07/MF A01

Results of a technical and economic evaluation of producing methanol from bituminous coal using Texaco coal gasification and ICI methanol synthesis is reported. The scope of work included: development of an overall configuration for a large plant comprising coal preparation, air separation, coal gasification, shift conversion, COS hydrolysis, acid gas removal, methanol synthesis, methanol refining, and all required utility systems and off-site facilities. Design data were received from both Texaco and ICI while a design and cost estimate were received from Lotepro covering the Rectisol acid gas removal unit. The plant processes 14,448 tons per day (dry basis) of Illinois No. 6 bituminous coal and produces 10,927 tons per day of fuel-grade methanol. An overall thermal efficiency of 57.86 percent was calculated on an HHV basis and 52.64 percent based on LHV. Total plant investment at an Illinois plant site was estimated to be $1159 million dollars in terms of 1979 investment. Using EPRI's economic premises, the first-year product costs were calculated to $4.74 per million Btu (HHV) which is equivalent to $30.3 cents per gallon and $5.37 per million Btu. DOE

N82-17399# Hydrocarbon Research, Inc., Lawrenceville, N. J.
H-COAL PROCESS IMPROVEMENT STUDY: BENCH-UNIT BASELINE RUN WITH PREHEATER/REACTOR
May 1981 57 p
(Contract DE-AC05-77ET-10152)
(DE82-002572; DOE/ET-10152/T2) Avail: NTIS HC A04/MF A01

The thermal dissolution of coal and its effects on the mechanism of coal liquefaction in an H-Coal system were investigated. The two-state coal liquefaction system consists of a coal slurry preheater and a liquefaction reactor, a catalytic-hydrogenation-reactor. The preheater design and unit modifications are discussed. The objective of the run reported was to obtain baseline data with the preheater integrated in the bench unit system. Operating conditions and results are summarized and compared with those of previous bench runs without a preheater. The effect a preheater has on product yields and product quality was determined. Based on comparison data it is concluded that a preheater tends to increase heavy liquid yields with more residual oil and a higher proportion of heavy distillates in the distillate product. However, more experimental data at comparable operating conditions, with and without a preheater, are needed to confirm this observation. The experimental run closely simulated the conditions of another run which also included a preheater; however, product yields differed by as much as 6 w %. The higher slurry space velocities in the preheater for this run correspond to lower slurry residence times, which resulted in lower yields of lighter fractions than obtained in PDU Run 5. DOE

N82-17400# Cummins Engine Co., Inc., Columbus, Ohio.
SYNFUEL MODIFIED DIESEL Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981
1981 16 p
(Contract DE-AC03-79ET-15450)
(DE82-002298; DOE/ET-15450/T18) Avail: NTIS HC A02/MF A01

A two-year program was proposed to test three diesel engines operating on coal-derived liquid fuels and compare the results with standard diesel fuel oil No. 2; namely: (1) prechamber diesel; (2) dual fuel diesel (direct injection); and (3) spark-assisted diesel engines. The three types of diesel engines tested were to be modified in three forms: (1) conventional water-cooled; (2) waterless-uncooled; and (3) adiabatic (uncooled). Only the conventional water-cooled prechamber diesel engine and the spark assisted prechamber diesel engine were studied. Subcontracts were let to test the prechamber diesel engine and the spark-assisted prechamber. The direct injection dual fuel engine test will be delayed until the second year of the contract. No engine modifications for waterless-uncooled and adiabatic uncooled are scheduled for the first year. The selected engine models were installed in the laboratory. Preliminary operation was made. Both subcontractors began to construct a particulate measuring system according to recommendations. DOE

N82-17401# Chevron Research Co., Richmond, Calif.
REFINING AND UPGRADING OF SYNFUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Interim Report
R. F. Sullivan, D. J. ORear, and H. A. Frumkin Sep. 1981 319 p refs
(Contracts DE-AC22-76ET-10532; EF-76-C-01-2315)
(DE82-001127; DOE/ET-10532/T3; FE-2315-61; IR-5) Avail: NTIS HC A14/MF A01

Two coal syncrudes derived from Illinois No. 6 and Wyodak coals were refined in a extensive program which included pilot plant and laboratory studies. These studies demonstrated that advanced, commercial petroleum technology can be used to refine these syncrudes to gasoline, jet, diesel and heating fuels. The coal syncrudes have a low hydrogen content, compared to petroleum, and high concentrations of oxygen and nitrogen impurities. These syncrudes are a blend of two coal distillates boiling between C sub 5 and 680 F. Consequently, they contain no residual and have about 95% boiling in the gasoline or diesel fuel ranges. With these properties, an appropriate way to refine the syncrudes is by hydroprocessing. Hydroprocessing yields a volume of finished products which is almost equivalent to the original volume of syncrude. In addition, the heteroatoms are ultimately removed as sulfur and salable ammonia. The engineering studies provided estimates of the refining costs. DOE

N82-17402# Chevron Research Co., Richmond, Calif.
REFINING AND UPGRADING OF SYNFUELS FROM COAL AND OIL SHALES BY ADVANCED CATALYTIC PROCESSES Quarterly Report, Apr. - Jun. 1981
R. F. Sullivan and D. J. ORear Sep. 1981 35 p
(Contracts DE-AC22-76ET-10532; EF-76-C-01-2315)
(DE81-030849; DOE/ET-10532/T2) Avail: NTIS HC A03/MF A01

Samples of solvent refined coal 2 middle and heavy distillates were water-washed and blended for use in a study of the potential biological hazards of synthetic crudes. A pilot plant screening was started on the blended distillate. Syncrude derived from Big Brown Texas lignite was analyzed and hydrotreated in a pilot plant. Early results show that properties and response to hydrotreating of the syncrude are similar to the results found on H-coal and solvent refined coal 2 syncrudes. DOE

N82-17404# Institute of Gas Technology, Chicago, Ill.
RAPID-RATE BITUMINOUS COAL GASIFICATION Final Report, Sep. 1978 - Dec. 1980
D. Q. Tran Aug. 1981 71 p refs
(Contract GRI-5011-322-0082)
(PB82-115478; GRI-79/0104) Avail: NTIS HC A04/MF A01 CSCL 21D

A free-fall, laminar-flow reactor capable of studying the devolatilization of caking coals was constructed. The unit can provide kinetic data as a function of several process variables, including temperature, pressure, residence time and reactive gas composition at temperatures to 1600 F and pressures to 1500 psig. The reactor system was used successfully to obtain devolatilization data for two caking coals, Illinois No. 6 and Pittsburgh No. 8. Limiting (maximum) yields of CO, CO2, H2O, and CH4 were obtained for these two coals, and correlations were developd to predict the yield of these species from the H/C and O/C ratio of the raw coal. Author (GRA)

N82-17450# Westinghouse Electric Corp., East Pittsburgh, Pa.
EVALUATION OF CONTROL AND PROTECTION CIRCUITS Open File Report, 13 Nov. 1979 - 31 Mar. 1981
E. C. Strycula and D. A. Paice Apr. 1981 50 p refs
(Contract DI-BM-JO-308035)
(PB82-105065; BM-OFR-126-81) Avail: NTIS HC A03/MF A01 CSCL 08I

Solid state equipment offers a number of potential advantages in the coal mining industry. These advantages can only be realized, however, through careful and judicious design of the control and protection circuitry. Problems relating to the interaction of solid state equipment on the electrical system and the special design considerations that apply to solid-state circuitry are examined. Design guidelines are provided for solid-state applications in the areas of: (1) equipment operated from a dc trolley wire, (2) drive systems for surface mining equipment, (3) ac motor starters, and (4) electromagnetic interference. GRA

N82-17455# Technische Univ., Aachen (West Germany). Inst. of Ferrous Metallurgy.
PRELIMINARY INVESTIGATIONS ON THE INJECTION OF A COAL-OIL-SLURRY INTO THE BLAST FURNACE Final Report
Ulrich Rejek and Friedrich Hermann Franke Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 83 p refs Sponsored by the Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-221; ISSN-0340-7608) Avail: NTIS HC A05/MF A01

The flow and pumping behaviour and sedimentation of coal-oil-slurries as a function of concentration, temperature, coal and oil type, grain size, size distribution, pipe geometry etc. were determined. The results are intended to facilitate the planning of an injection plant and to enable an assessment of the economic feasibility of such a plant. The results show that for trouble-free transportation, (without undue increase in viscosity) the maximum coal concentration is 50 percent by weight with lignite coal-oil-slurries and 65 percent by weight with bituminous low volatile coal-oil-slurries at 80 C. A fine grinding of the coals leads to high viscosity in the slurries. The utilization of coarse particles leads to a rapid sedimentation at low velocities. T.M.

N82-17507# CLD Group, Inc., Ventura, Calif.
FIELD DEMONSTRATION OF THE CONVENTIONAL STEAM DRIVE PROCESS WITH ANCILLARY MATERIALS Annual Report, 1 Oct. 1979 - 30 Sep. 1980
Ron Bowman Oct. 1981 133 p refs
(Contract DE-FC03-79SF-10761)
(DE82-003040; DOE/SF-10761/1; AR-1) Avail: NTIS HC A07/MF A01

The applicability of foams to achieve mobility control and/or permeability reduction of injected steam in steam drive operations was tested. Foam chemicals were screened for thermal stability and the foam systems in porous media were emplaced. The compatibility of the emplacement techniques and the capacity of the chemical system to achieve a significant measure of mobility control over injected steam was verified. The two major reservoir problems in steam drive operations are addressed: the flow of steam through thief zones or other channels that exist at the outset of initiating operations, and the progressive increase in channelling of steam through the oil depleted, steam swept zone. DOE

N82-17508# Consolidated Controls Corp., El Segundo, Calif.
DESIGN, FABRICATION, AND EVALUATION OF A SPIRAL-FLOW LETDOWN VALVE Final Report
H. J. Balhouse Sep. 1981 68 p refs
(DE82-900863; EPRI-AP-2044) Avail: NTIS HC A04/MF A01

A letdown valve with spiral-flow trim designed for coal liquefaction plant service was designed and tested. Letdown valves in these plants have tended to fail in a very short time due to rapid erosion of the valve trim. In the spiral-flow design, erosion is reduced by keeping velocity at a low, constant level through friction loss in a long spiraling flow path. In a field test at the

SRC-1 pilot plant, the valve controlled the processes flow for over 34 hours before it became inoperative as a result of plugging due to accumulation of solids in operational areas. It is concluded that in order to realize the potential advantages of the spiral-flow concept, more development effort is needed in the areas of prevention of plugging and the application of erosion-resistant materials and coatings. Directions for future work in these areas, plus application of the concept to a non-cavitating liquid letdown valve and other pressure reduction devices, are discussed. DOE

N82-17552# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
HELIUM PRODUCTION IN NATURAL GAS RESERVOIRS
E. B. Pereira and J. A. S. Adams (Rice Univ., Houston, Tex.) Aug. 1981 14 p refs Submitted for publication
(INPE-2214-PRE/014) Avail: NTIS HC A02/MF A01

About 11,000 published natural gas analyses of helium were used in the estimation of the average global scale accumulation and concentration of radiogenic helium in sediments. Simple lognormal statistics are employed to derive a net accumulation rate between 1000,000 to 670,000 helium atoms per cubic meter of reservoir rock per second. This accumulation rate permits an inference of an average helium concentration of non-reservoir sediments of about 67 ppm. By assuming a simple closed system model, it is shown that deep seated sources of helium are not necessary to explain the present regime of helium in sediments on a global scale, and that the accumulation rate and concentration obtained are in close agreement with existing fundamental geochemical estimates of uranium and thorium in rather average type of sediments. R.J.F.

N82-17553*# Wyle Labs., Inc., Huntsville, Ala. Scientific Services and Systems Group.
BASELINE STUDIES ON THE FEASIBILITY OF DETECTING A COAL/SHALE INTERFACE WITH A SELF-POWERED SENSITIZED PICK Final Report
Granville R. Anderson, II 19 Feb. 1981 98 p refs
(Contract DEN8-000011)
(NASA-CR-161960) Avail: NTIS HC A05/MF A01 CSCL 08I

The feasibility of utilizing a sensitized pick to discriminate between cutting coal and roof material during the longwall mining process was investigated. A conventional longwall mining pick was instrumented and cutting force magnitudes were determined for a variety of materials, including Illinois #6 coal, shale type materials, and synthetic coal/shale materials. E.A.K.

N82-17554*# Mississippi State Univ., Mississippi State. Engineering and Industrial Research Station.
THE DESIGN OF A MECHANICAL REFERENCING SYSTEM FOR THE REAR DRUM OF THE LONGWALL SHEARER COAL MINER Final Report
E. William Jones and Thomas Chen-Hsing Yang 4 Jun. 1981 78 p refs
(Contract NCA8-00131)
(NASA-CR-161962; MSSU-EIRS-ME-81-4) Avail: NTIS HC A05/MF A01 CSCL 08I

The design of two systems which reference the position of a longwall shearer coal miner to the mine roof of the present cut and of the last cut are presented. This system is part of an automation system that will guide the rear cutting drum in such a manner that the total depth of cut remains constant even though the front drum may be following an undulating roof profile. The rear drum referencing mechanism continually monitors the distance from the mine roof to the floor for the present cut. This system provides a signal to control a constant depth of cut. The last cut follower mechanism continually monitors the distance from the mine roof of the prior cut to the cutting drum. This latter system provides a signal to minimize the step height in the roof between cuts. The dynamic response of this hydraulic-pneumatic and mechanical system is analyzed to determine accumulator size and precharge pressure. B.W.

N82-17555*# Missouri Univ., Rolla. Rock Mechanics and Explosives Research Center.
THE DETECTION OF THE COAL ROOF INTERFACE BY USE OF HIGH PRESSURE WATER Final Report
1981 55 p refs
(Grant NsG-8055)
(NASA-CR-161959) Avail: NTIS HC A04/MF A01 CSCL 08I

A device whereby water jets can be used to detect the interface between coal and the overlying roof rock is described. Once this identification is made this distance can be measured using instruments such as the autofocus systems recently developed in the photographic industry. Experiments carried out show that the device can discriminate between coal and rock at coal thicknesses up to 8 inches. An autofocus system was examined which indicates accuracies of better than 0.1 inches. B.W.

N82-17560*# Shaker Research Corp., Ballston Lake, N. Y.
DEVELOPMENT OF SENSITIZED PICK COAL INTERFACE DETECTOR SYSTEM Final Report
R. F. Burchill [1982] 68 p
(Contract NAS8-32538)
(NASA-CR-161961) Avail: NTIS HC A04/MF A01 CSCL 08I

One approach for detection of the coal interface is measurement of pick cutting loads and shock through the use of pick strain gage load cells and accelerometers. The cutting drum of a long wall mining machine contains a number of cutting picks. In order to measure pick loads and shocks, one pick was instrumented and telemetry used to transmit the signals from the drum to an instrument-type tape recorder. A data system using FM telemetry was designed to transfer cutting bit load and shock information from the drum of a longwall shearer coal mining machine to a chassis mounted data recorder. The design of components in the test data system were finalized, the required instruments were assembled, the instrument system was evaluated in an above-ground simulation test, and an underground test series to obtain tape recorded sensor data was conducted. T.M.

N82-17564# Sheffield Univ. (England). Dept. of Control Engineering.
THE MODELLING OF SEMIFLEXIBLE CONVEYOR STRUCTURES FOR COAL-FACE STEERING INVESTIGATIONS. PART 1: SPATIALLY DISCRETE MODELS
J. B. Edwards, R. A. Wolfenden (National Coal Board), and A. M. S. R. Yazdi Apr. 1981 35 p refs Submitted for publication 2 Vol.
(RR-151-Pt-1) Avail: NTIS HC A03/MF A01

The coal-cutting machine shown is of the ranging-drum shearer type. The machine both cuts the coal from the solid face as it proceeds along the face and simultaneously loads the product onto the scraper-chain conveyor. This operation is aided by the spiral vanes around the rotating drum periphery upon which the cutting picks are mounted. The scraper-chain conveyor also has more than a single function: it not only conveys the cut product to the face-end but, because of the robust construction if its structure, it also provides a comparatively smooth track upon which the power-loader rides. Mathematical models of the steering system and the overall process are presented. Examples of predicted behavior are given. J.M.S.

N82-17565# Sheffield Univ. (England). Dept. of Control Engineering.
THE MODELLING OF SEMIFLEXIBLE CONVEYOR STRUCTURES FOR COAL-FACE STEERING INVESTIGATIONS. PART 2: SPATIALLY CONTINUOUS MODELS
J. B. Edwards Apr. 1981 25 p refs Submitted for publication 2 Vol.
(RR-152-Vol-2) Avail: NTIS HC A02/MF A01

A linear model of a flexible conveyor used on longwall coal-faces and designed to permit vertical floor undulations to be followed is presented along with a continuous elastic beam model. Predictions of the multipass system stability using the beam model are discussed. J.M.S.

N82-17572# Donohue, Anstey, and Morrill, Boston, Mass.
A PROJECT TO TEST FOR SHALE GAS IN OHIO Final Report
30 Apr. 1981 197 p
(Contract DE-AC21-78MC-08339)
(DE82-000916; DOE/MC-12697/T3) Avail: NTIS HC A08/MF A01

Methods to find deep zones of natural fracture in the search for viable shale gas are discussed. The measurement of seismic velocity in the shale is examined. This speed is expected to be lowered by the presence of fractures, particularly if the fractures contain gas. The seismic reflection method, which times the

echoes from deep rock layers, is used to measure the speed of sound in the shale. The results of the seismic velocity analysis are summarized. Gas was obtained from two naturally fractured zones in the Chagrin shale. The well was stimulated and tested at three separate levels: the Rhinestreet shale, Huron shale, and the Chagrin. DOE

N82-17573# Donohue, Anstey, and Morrill, Boston, Mass.
SHALE GAS IN THE SOUTHERN CENTRAL AREA OF NEW YORK STATE: PART 1. HOW TO FIND AND DEVELOP SHALE GAS IN NEW YORK STATE
Apr. 1981 71 p Sponsored in part by New York Energy Research and Development Authority
(Contract DE-AC21-79MC-12697)
(DE82-000913; DOE/MC-12697/T1) Avail: NTIS HC A04/MF A01

The economics of shale-gas exploration in New York are discussed. To date three wells have been artificially fractured in the Marcellus shale of New York, and all three appear to be producers. The chances of extracting gas are improved if geological techniques can identify zones of a suitable degree of natural fracturing in the shale. These techniques are aided by detailed structure maps of the shale units. It is concluded that the most likely source of shale gas in south central New York is the Marcellus formation. The following recommendations are made: shale gas wells should be drilled with air; the dry open hole should be logged with gamma-ray, density, temperature and noise logs; the shale should be artificially fractured using a nitrogen stimulation technique. DOE

N82-17574# Commercialization Insights, Tampa, Fla.
EVALUATION OF ALTERNATIVES IN DOWNHOLE STEAM GENERATION
Sep. 1981 82 p Sponsored by DOE
(DE82-001943; DOE/TIC-2001943) Avail: NTIS HC A05/MF A01

The development of downhole steam generators for requirements of commercialization, technical, and economic goals were evaluated. It is found that: (1) the high pressure downhole steam generator has potential for commercialization in the production of heavy oil; (2) oil yield is the critical performance parameter; (3) the downhole hydrogen/oxygen has potential for production of resources which are not unproducible or uneconomical; (4) the critical performance provided in nearly 1100 pre and posttraining forms returned by the solar and 201 stream sediment samples. Statistical and areal distributions of uranium and possible uranium related variables are displayed. Pertinent geologic factors in evaluating the potential for uranium mineralization are discussed. The high uranium values occur primarily in pleistocene delta deposits and in glacial outwash and till. Groundwater in this area is geographically associated with high values of calcium, magnesium, manganese, potassium, selenium, strontium, sulfate, and total alkalinity. DOE

N82-17575# New Mexico Inst. of Mining and Technology, Socorro. Petroleum Recovery Research Center.
DEVELOPMENT OF MOBILITY CONTROL METHODS TO IMPROVE OIL RECOVERY BY CO2 Quarterly Report, 1 Jul. - 30 Sep. 1981
J. P. Heller 1981 6 p refs
(Contract DE-AC21-79MC-10689)
(DE82-001968; DOE/MC-10689/10; PRRC-81-41; QR-8)
Avail: NTIS HC A02/MF A01

The development of foam-type mobility control agents, core flooding system, and direct thickeners consisting of polymers soluble in CO2 are discussed. The core flooding test system is operational with all components essentially complete. Foam generation was principally concerned with experiments designed to ascertain the proper operating regions for the generator. The second mobility agent is being developed for the direct thickness of CO2. A number of polymeric compounds were found which are soluble in CO2. DOE

N82-17576# Gruy Federal, Inc., Houston, Tex.
TARGET RESERVOIRS FOR CO2 MISCIBLE FLOODING, TASK TWO. SUMMARY OF AVAILABLE RESERVOIR AND GEOLOGICAL DATA. VOLUME 1: PERMIAN BASIN GEOLOGICAL AND RESERVOIR DATA. PART 2: ADAIR-SAN ANDRES THROUGH EUNICE Final Report
L. B. Cobb Oct. 1981 336 p refs
(Contract DE-AC21-79MC-08341)
(DE82-001348; DOE/MC-08341/31-Vol-1-Pt-2) Avail: NTIS HC A15/MF A01

The types of injected fluid, type of injector, fluid status, efficiency of type injector, injection pattern, and operational problems are coded and tabulated for oil and gas reservoirs in New Mexico and Texas. Water analysis records are included. DOE

N82-17595# Institute of Gas Technology, Chicago, Ill.
ANALYSIS OF GEOPRESSURED AQUIFERS Annual Report, Jan. - Dec. 1980
M. G. Doherty Aug. 1981 155 p refs
(Contract GRI-5011-310-0109)
(PB82-103862; GRI-80/0072) Avail: NTIS HC A08/MF A01 CSCL 08I

The Institute of Gas Technology undertook technical and economic analyses of the coproduction of water and gas from watered-out geopressured gas caps, hydropressured aquifers, and low-permeability geopressured aquifers for the Gas Research Institute. Out of over 100,000 wells screened in Louisiana and Texas, 489 were identified as having watered out under a strong water drive, making them possible candidates for watered-out geopressured gas cap wells. GRA

N82-17603*# Gilbert/Commonwealth, Reading, Pa.
MAGNETOHYDRODYNAMICS (MHD) ENGINEERING TEST FACILITY (ETF) 200 MWe POWER PLANT CONCEPTUAL DESIGN ENGINEERING REPORT (CDER) Final Report
Sep. 1981 593 p refs
(Contracts DEN3-224; DE-AI01-77ET-10769)
(NASA-CR-165452-Vol-5; DOE/NASA/0224-1-Vol-5) Avail: NTIS HC A25/MF A01 CSCL 10B

The reference conceptual design of the magnetohydrodynamic (MHD) Engineering Test Facility (ETF), a prototype 200 MWe coal-fired electric generating plant designed to demonstrate the commercial feasibility of open cycle MHD, is summarized. Main elements of the design, systems, and plant facilities are illustrated. System design descriptions are included for closed cycle cooling water, industrial gas systems, fuel oil, boiler flue gas, coal management, seed management, slag management, plant industrial waste, fire service water, oxidant supply, MHD power train, magnet, heat recovery/seed recovery, inverter, heating, ventillating, and air conditioning, and electrical. N.W.

N82-17618# Kernforschungsanlage, Juelich (West Germany).
METEOROLOGICAL DATA BASIS
L. Jarass (ATW, G.M.B.H., Regensburg, West Germany) *In its* Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 1-16

Avail: NTIS HC A08/MF A01

Wind speed and direction data from 16 observation points in the Federal Republic of Germany are evaluated. Hourly mean figures for wind speed and direction, measured at heights of 10 m to 30 m above ground, for the years 1969 to 1976 at coastal stations and for the years 1969 and 1972 at inland stations, are analyzed. Daily and seasonal time variations and the temporal distribution of wind speed, lulls, and correlation and autocorrelation of wind speeds are considered and charted. Extreme velocities are discussed. A general evaluation of possible sites for wind power generation facilities is presented. J.D.H.

N82-17629# Amax Exploration, Inc., Wheat Ridge, Colo.
TUSCARORA AREA, NEVADA: GEOTHERMAL RESERVOIR ASSESSMENT CASE HISTORY, NORTHERN BASIN AND RANGE Final Report, 1 Oct. 1978 - 9 Sep. 1980
H. D. Pilkington Aug. 1981 45 p refs
(Contract DE-AC08-79ET-27011)
(DE82-001328; DOE/ET-27011/1) Avail: NTIS HC A03/MF A01

A Geothermal exploration of the Tuscarora prospect consisted of an integrated program of geologic, hydrogeochemical and soil geochemistry studies. Geophysical exploration included: heatflow studies, aeromagnetic, self potential, gravity, dipole-dipole resistivity and magnetotelluric surveys. Exploration drilling includes 32 shallow thermal gradient holes; six intermediate depth temperature gradient wells and one 5454 foot test for discovery well. Shallow low temperature reservoirs were encountered in the Tertiary rocks and in the Paleozoic rocks immediately beneath the Tertiary. DOE

N82-17630# Gilbert (Glen A.) and Associates, Inc., Reading, Pa.

RESEARCH AND EVALUATION OF BIOMASS RESOURCES/CONVERSION/UTILIZATION SYSTEMS. BIOMASS ALLOCATION MODEL. VOLUME 1: TEST AND APPENDICES A & B

R. P. Stringer, Y. K. Ahn, H. T. Chen, R. W. Helm, E. T. Nelson, and K. J. Shields Aug. 1981 222 p refs 2 Vol.

(Contract DE-AC02-78ET-20611)

(DE82-000838; DOE/ET-20611/12-Vol-1; GAI-2204-Vol-1) Avail: NTIS HC A10/MF A01

A biomass allocation model was developed to show the most profitable combination of biomass feedstocks, thermochemical conversion processes, and fuel products to serve the seasonal conditions in a regional market. This optimization model provides a tool for quickly calculating which of a large number of potential biomass missions is the most profitable mission. Other components of the system serve as a convenient storage and retrieval mechanism for biomass marketing and thermochemical conversion processing data. The system can be accessed through the use of a computer terminal, or it could be adapted to a microprocessor. A User's Manual for the system is included. Biomass derived fuels included in the data base are the following: medium Btu gas, low Btu gas, substitute natural gas, ammonia, methanol, electricity, gasoline, and fuel oil. DOE

N82-17631# Gilbert (Glen A.) and Associates, Inc., Reading, Pa.

RESEARCH AND EVALUATION OF BIOMASS RESOURCES/CONVERSION/UTILIZATION SYSTEMS. BIOMASS ALLOCATION MODEL. VOLUME 2: APPENDICES C-E

R. P. Stringer, Y. K. Ahn, H. T. Chen, R. W. Helm, E. T. Nelson, and K. J. Shields Aug. 1981 323 p refs 2 Vol.

(Contract DE-AC02-78ET-20611)

(DE82-000839; DOE/ET-20611/12-Vol-2; GAI-2204-Vol-2) Avail: NTIS HC A14/MF A01

The Biomass Feedstock Allocation Model User's Manual is presented. The results of an economic analysis of biomass thermochemical conversion processes are presented as: a sample computer run for process economics; process cost sensitivity plots (the effect of plant capacity and feedstock cost on product cost); and the results of a computer analysis showing product costs using discounted cash flow and utility financing method. The results of process modeling activities are also included. DOE

N82-17690# Colorado State Univ., Fort Collins. Dept. of Agronomy.

FIELD STUDIES ON USBM AND TOSCO 2 RETORTED OIL SHALES: VEGETATION, MOISTURE, SALINITY, AND RUNOFF Final Report, 1977 - 1980

M. K. Kilkelly, W. A. Berg, and H. P. Harbert, III Aug. 1981 120 p refs

(Grant EPA-R-804719)

(PB82-109810; EPA-600/7-81-139) Avail: NTIS HC A06/MF A01 CSCL 13B

The vegetative stabilization of processed oil shales and moisture and soluble salt movement within the soil/shale profile were investigated. Research plots with two types of retorted shales (TOSCO II and USBM) with leaching and soil cover treatments were established at two locations: low-elevation and high elevation. Vegetation was established by intensive management, N and P fertilization, seeding, mulching, and irrigation. After seven growing seasons, a good vegetative cover remains with few differences between treatments, with the exception of the TOSCO retorted shale, south aspect, which consistently supports less perennial vegetative cover than other treatments. With time, a shift from perennial grasses to dominance by shrubs is observed. GRA

N82-17696 Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Geological Survey of Queensland.

GEOLOGICAL EVOLUTION AND ECONOMIC GEOLOGY OF THE BURDEKIN RIVER REGION, QUEENSLAND

K. R. Lavingston and W. H. Oldham, ed. 1981 72 p refs

(BMR-BULL-208; ISSN-0084-7089; ISBN-0-642-05830-X) Avail: NTIS HC A04

The geological history of the area is presented, from the Precambrian to the Cainozoic ages. The physiography of the land is described, and the economic aspects of the geology are discussed in relation to metals, fuels (coal and petroleum), and nonmetallic minerals. S.L.

N82-17722# Research Inst. of National Defence, Stockholm (Sweden).

SEISMOLOGY 1980, NUCLEAR TEST BAN VERIFICATION, EARTHQUAKE AND EARTH RESOURCE INVESTIGATION Progress Report, 1980

Brittmarie Tygaard Oct. 1981 69 p refs Sponsored by National Council for Radioactive Waste

(FOA-C-20427-T1) Avail: NTIS HC A04/MF A01

Seismological projects are reported, including nuclear explosion monitoring, the development of international data centers, seismic risk estimation for nuclear power plants, oil exploration using seismic methods, and crystalline rock investigation using seismic cross hole measurements. The Swedish seismic network is described. In 1980, China conducted 1 nuclear test, France 11, Britain 3, the US 14, and the USSR 21. Apart from the Chinese test, the explosions were underground and within the 150 kton limit. France is the only country which increased the number of tests compared with previous years. Author (ESA)

N82-17739 Columbia Univ., New York.

ANOMALOUS RADON (222) EMISSION AND ITS ASSOCIATION WITH EARTHQUAKES AND TECTONISM Ph.D. Thesis

Egill Hauksson 1981 161 p

Avail: Univ. Microfilms Order No. 8125301

During 1978 and 1979 radon content in groundwater from nine geothermal wells in Iceland was monitored to correlate possible precursory changes in radon content with local seismicity. Radon emission from fumaroles at Krafla volcano in north Iceland was monitored to establish a possible relationship between radon emission and ongoing episodic microseismicity, rifting, and volcanism. To shed light on the physical basis of anomalous radon emission as a precursor to earthquakes, world-wide radon data are interpreted in terms of recent results in rock mechanics. Dissert. Abstr.

N82-17753# Pakistan Meteorological Dept., Karachi.

METEOROLOGICAL EVALUATION OF WIND ENERGY POTENTIAL IN THE COASTAL BELT OF PAKISTAN

Muhammad Rahmatullah and Qazi Waliullan *In* WMO Tech. Conf. on Climate: Asia and Western Pacific 1981 p 127-138 refs

Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

Recent improvements in windmill design and the automatic arrangement for the use of a rotor to turn at a low chosen wind speed requires a reappraisal of wind power potential particularly in the coastal belt of Pakistan. Wind data is analyzed to determine the prevailing wind duration within various ranges of speeds at these stations. S.L.

N32-17782# ESCAP, Bangkok (Thailand).

EFFECT OF CLIMATE ON THE DEVELOPMENT OF NATURAL RESOURCES IN ASIA

B. X. Zhang *In* WMO Tech. Conf. on Climate: Asia and Western Pacific 1981 p 439-445

Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 28

Since climate is considered to be a consequence of average values in the basic meteorological elements of temperature, moisture, wind, pressure, and evaporation, these average values are used to develop a general criterion for use in planning and managing the development of natural resources. Emphasis is placed on early recognition that an abnormal climatic cycle may be developing and an accurate weather forecast to pinpoint the location and geographic extent of the disaster. The interrelationships between climate and development are addressed in the following areas: human resources, animal and range resources, agricultural resources, forest resources, fishery resources, water resources, mineral resources, and energy resources. J.M.S.

N82-18406# Dynecology, Inc., Harrison, N.Y.

ADAPTATION OF THE SIMPLEX GASIFICATION PROCESS TO THE COCONVERSION OF MUNICIPAL SOLID WASTE AND SEWAGE SLUDGE

J. C. Arbo, D. P. Glaser, M. A. Lipowicz, R. B. Schulz, and J. L.

Spencer Apr. 1981 54 p Sponsored in part by EPA
(PB82-112418; NYSERDA-81-6) Avail: NTIS
HC A04/MF A01 CSCL 21D

The combining of coal with biomass and sewage sludge in varying ratios to form simplex briquettes to be fed into gasifiers was examined. The use of biomass sewage sludge and municipal solid wastes permit the use of Eastern-caking coals in commercial medium Btu gasifiers. The results found that many of the 225 experimental briquette formulations meet required structural integrity prevent the clumping and fusing that have hindered effective gasification of this type of coal; and meet storage criteria. The briquettes developed, if commercially available, could convert an urban disposal problem into an energy resource permitting the use of less expensive and more readily available Eastern coal. GRA

N82-18407# Gilbert (Glen A.) and Associates, Inc., Reading, Pa.

COMPARISON OF COAL BASED SYSTEMS: MEDIUM-BTU GAS VERSUS SNG FOR INDUSTRIAL APPLICATIONS Final Report

Michael D. Peterik 1 May 1981 202 p refs
(Contract GRI-5014-310-0195)
(PB82-117383; GRI-80/0058) Avail: NTIS
HC A10/MF A01 CSCL 21D

Production and total system economics of fuel gas from coal for industrial use were analyzed. It was found that low-Btu gas offers industry certain cost advantages over higher heat content fuel gases in specific applications, but that its use will be characterized by small scale on-site systems. Intermediate Btu gas (IBG), on the other hand, offers an incentive for gas industry involvement because of potential cost reduction to industry through a regional, centralized, utility owned system. Synthetic natural gas costs, benefiting from economics of scale and plant siting, offer industry the lowest cost alternative for the majority of systems studied. Author (GRA)

N82-18408# National Center for Resource Recovery, Washington, D. C.

DENSIFICATION OF REFUSE-DERIVED FUELS: PREPARATION, PROPERTIES AND SYSTEMS FOR SMALL COMMUNITIES Final Report

Jay Campbell and Marc L. Renard Sep. 1981 163 p refs
(Grant EPA-R-804150)
(PB82-103904; EPA-600/2-81-188) Avail: NTIS
HC A08/MF A01 CSCL 21D

Densified refuse derived fuel (d-RDF) is produced by compacting refuse derived fuel into agglomerated pieces sufficiently cohesive to sustain storage and handling. The use of this d-RDF product as a substitute for coal in spreader stroke boilers is a developing resource recovery alternative. The operation, performance and product characteristics of a waste shredding and densification subsystem for production of d-RDF from air classified light fraction is investigated and a technical and economic evaluation of d-RDF facilities for small communities is presented. GRA

N82-18409# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.

STUDIES RELATED TO THE DEEP EARTH GAS Final Report, Sep. 1979 - Dec. 1980

Thomas Gold, Elizabeth Bilson, and Steven Soter 8 May 1981 40 p refs
(GRI Proj. 5014-363-0205)
(PB82-103821; GRI-80/0066) Avail: NTIS
HC A03/MF A01 CSCL 21D

The origin of terrestrial hydrocarbons, principally methane and petroleum and the importance of the abiogenic methane component in natural gas, which originates at much greater depth than the organic methane, from meteoritic carbonaceous matter accumulated in the mantle at the time of the Earth's formation. Experiments include: (1) inverse cracking designed to study the conditions for methane addition to petroleum hydrocarbons; (2) isotope analysis of methane was samples collected in geopressured wells, tectonically active regions, and seeps of possibly abiogenic origin; and (3) construction and testing of a ground gas pressure monitoring unit to be used for the investigation of the relationship of Earth outgassing and tectonic processes. GRA

N82-18410# California Univ., Berkeley. Dept. of Mechanical Engineering.

FUNDAMENTAL CONSIDERATIONS FOR PREPARING DENSIFIED REFUSE DERIVED FUEL Final Report

George J. Trezek, George M. Savage, and Daniel B. Jones Sep. 1981 59 p refs
(Grant EPA-R-805414)
(PB82-101668; EPA-600/2-81-180) Avail: NTIS
HC A04/MF A01 CSCL 21D

A series of pilot scale tests were conducted to determine the effects of various parameters on the densification of refuse derived fuel. The experiments included a series of bench scale experiments involving a single die arrangement, as well as larger scale studies in which a commercial pellet mill was used. The bench scale tests (tests in which the pellets were individually formed), were conducted both to provide data needed for an analysis of the basis dynamics of pellet formation and as an aid in the interpretation of results obtained with the pellet mill. The energy required to overcome die friction was studied independently of the energy consumed in material deformation and compression. The specific effects of die length, diameter, and taper were determined. GRA

N82-18412# Environmental Protection Agency, Ann Arbor, Mich. Control Technology Assessment and Characterization Branch.

GASOLINE EQUIVALENT FUEL ECONOMY DETERMINATION FOR ALTERNATE AUTOMOTIVE FUELS

Craig A. Harvey Aug. 1981 41 p refs
(PB82-120072; EPA/AA/CTAB/PA/81-16) Avail: NTIS
HC A03/MF A01 CSCL 21D

Some basis for a decision on the most appropriate methodology for calculating the gasoline equivalent fuel economy of a vehicle that uses fuel other than gasoline is provided. Once this methodology is determined, it will provide vehicle manufacturers with a way to gauge the effects of alternative marketing options on their average fuel economy. GRA

N82-18413# Ohio Dept. of Natural Resources, Columbus. Water Planning Unit.

SOUTH POINT GASOHOL PROJECT: A WATER ASSESSMENT STUDY

Carrie J. Groves, David Denig-Chakroff, and Arthur F. Woldorf May 1981 50 p refs
(Contract WR20424491)
(PB82-111485) Avail: NTIS HC A03/MF A01 CSCL 21D

Section 13 of the Federal Non-nuclear Energy Research and Development Act of 1974 provides for water assessment reports to be prepared by the Water Resources Council on commercial applications of energy technologies which may have a significant impact on water resources. A summary of the principal findings of the study are reported; (1) a description of the project, (2) water supply availability (3) an analysis of surface-water and groundwater resources with special attention given to potential water quantity/quality impacts of the project and (4) environmental and socio-economic effects of potential water resources impacts. GRA

N82-18414# West Virginia Univ., Morgantown.

AN ECONOMIC ANALYSIS OF COAL SUPPLY IN THE OHIO RIVER BASIN ENERGY STUDY REGION

Walter P. Page Oct. 1981 83 p refs
(Grant EPA-R-805585)
(PB82-113341; EPA-600/7-81-162) Avail: NTIS
HC A05/MF A01 CSCL 21D

Using the energy and fuel demand model developed for the Ohio River Basin Energy Study (ORBES) region (all of Kentucky, most of West Virginia, substantial portions of Illinois, Indiana and Ohio and southwestern Pennsylvania), coal production levels were projected. A separate research effort allocated the tonnage to producing districts by mine and coal type. The coal supply work focused on identifying the coal supply districts that have historically served the ORBES region and estimating the resource depletion costs associated with expanded levels of coal production between 1974 and 2000. GRA

N82-18422# Battelle Pacific Northwest Labs., Richland, Wash.

PHYSICAL AND CHEMICAL CHARACTERISTICS OF SYNTHETIC ASPHALT PRODUCED FROM LIQUEFACTION OF SEWAGE SLUDGE Final Report, Sep. 1979 - Apr. 1981

J. M. Donovan, T. R. Batter, R. K. Miller, and R. P. Lottman (Idaho Univ., Moscow) Oct. 1981 67 p refs
(Grant EPA-R-806790)

(PB82-119082; EPA-600/2-81-242) Avail: NTIS HC A04/MF A01 CSCL 13B

Direct thermochemical liquefaction of primary undigested municipal sewage sludge was carried out to produce a low molecular weight steam volatile oil, a high molecular weight synthetic asphalt, and a residual char cake. The latter product is capable of supplying the thermal energy requirements of the conversion process. The steam volatile oil has immediate value as a synthetic fuel oil. The synthetic asphalt may prove to be a useful cement for paving or for fuel or coking stock. The thermochemical liquefaction process should be capable of operating technically and in an environmentally acceptable manner in conjunction with many existing waste water treatment facilities. The overall feasibility of the process depends on the value of the oil and synthetic asphalt products as petroleum replacements, and on the costs associated with disposal of sludge. GRA

N82-18469# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Ice Engineering Research Branch.

ELECTROMAGNETIC SUBSURFACE MEASUREMENTS

Arnold M. Dean, Jr. Oct. 1981 24 p

(Proj. CWIS-31350)

(AD-A108192; CRREL-SR-81-23) Avail: NTIS HC A02/MF A01 CSCL 17/9

In 1974, personnel at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) began using an impulse radar system to profile accumulations of ice forms. The system was modified for effective use as a profiling system in a ground or airborne configuration, in certain high-noise environments. The system can penetrate fresh water and media with a high water content. Frazil and brash ice accumulations with approximately 50% water were profiled to a depth of 25 to 35 ft. As a result of the CRREL modifications, the system has found extensive and varied applications as a low-level remote sensing tool. Applications include profiling ice accumulations (including ice jams), river beds, sheet ice, permafrost, subsurface ice masses, river bank revetments through air-entrained water, snow covers, sea ice, icebergs, and peat bogs. Limited laboratory work has also shown that the impulse radar system may be able to detect oil and gas under sea ice. Selected applications and data are presented. Since it was used mainly for research, the CRREL system needs further development to make it useful to operational units. Additional development of hardware and software is recommended. GRA

N82-18571# National Bureau of Standards, Washington, D.C. National Engineering Lab.

MATERIALS FOR INSTRUMENTATION FOR FOSSIL ENERGY TECHNOLOGIES. A REVIEW AND PROGRAM PLAN OF RESEARCH AND DEVELOPMENT NEEDS

H. P. R. Frederikse, P. K. Schenck, G. R. Burns, R. R. Dils, and J. R. Whetstone Sep. 1981 135 p refs

(Contract EA-77-A-01-6010)

(PB82-116229; NBSIR-81-2348) Avail: NTIS HC A07/MF A01 CSCL 14B

The materials problems related to instrumentation for Fossil Energy Facilities are reviewed. Requirements for measurement of process parameters (flow, temperature, pressure, chemical composition), of construction material properties, and of fuel characteristics are discussed. The main part of the report is a suggested program plan for pertinent materials R&D. Short descriptions of the various Fossil Energy Processes, listing of present research activities, and a set of 6 case studies are presented in an appendix. GRA

N82-18690*# United Technologies Corp., South Windsor, Conn. Power Systems Div.

LOW NO SUBx HEAVY FUEL COMBUSTOR CONCEPT PROGRAM. PHASE 1A: COAL GAS ADDENDUM Final Report, 29 Jun. - Oct. 1981

Thomas Rosfjord and Richard Sederquist Jan. 1982 43 p refs

(Contract DEN3-149; DE-AI01-77ET-13111)

(NASA-CR-165577; DOE/NASA/0149-2; GTR-3932) Avail: NTIS HC A03/MF A01 CSCL 10B

The performance and emissions from a rich-lean combustor fired on simulated coal gas fuels were investigated using a 12.7-cm diameter axially-staged burner originally designed for operation with high heating value liquid fuels. A simple, tubular fuel injector was substituted for the liquid fuel nozzle; no other combustor modifications were made. Four test fuels were studied including three chemically bound nitrogen-free gas mixtures with higher heating values of 88, 227, and 308 kj/mol (103, 258 and 349 Btu/scf), and a 227 kj/mol (258 Btu/scf) heating value doped with ammonia to produce a fuel nitrogen content of 0.5% (wt). Stable, ultra-low nitrogen oxide, smoke-free combustion was attained for the nitrogen-free fuels. Results with the doped fuel indicated that less than 5% conversion of NH3 to nitrogen oxide levels below Environmental Protection Agency limits could be achieved. In some instances, excessive CO levels were encountered. It is shown that use of a burner design employing a less fuel-rich primary zone than that found optimum for liquid fuels would yield more acceptable CO emissions. A.R.H.

N82-18712# Vereinigte Elektrizitaetswerke Westfalen A.G., Dortmund (West Germany). Hauptbereich Maschinentechnik.

CONSTRUCTION AND OPERATION OF A ONE TON PER HOUR PILOT PLANT FOR THE VEW COAL CONVERSION PROCESS Final Report, Feb. 1981

Juergen Poller Bonn Bundesministerium fuer Forschung und Technology Nov. 1981 57 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology

(BMFT FB-T-81-177; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 12,20

The pilot plant is based on airblown partial gasification in an entrained reactor. Results show that at temperatures of about 1450 C, 55% to 65% of the feed coal, and 70% to 80% of the sulfur can be converted into product gas. The quality of the low BTU gas is sufficient for application in the combined gas-stream turbine process. Extensive knowledge is also gained concerning gas accompanying pollutants and the behavior of different brickwork materials in the reactor environment. The acquired data allows proper dimensioning of a prototype plant. Author (ESA)

N82-18737# Kentucky Univ., Lexington.

A BASELINE ASSESSMENT OF COAL INDUSTRY STRUCTURE IN THE OHIO RIVER BASIN ENERGY STUDY REGION

David S. Walls, Dwight B. Billings, Mary P. Payne, and Joe F. Childers, Jr. Apr. 1981 581 p refs Prepared in cooperation with Ohio River Basin Energy Study

(Grant EPA-R-805585)

(PB82-103615; EPA-600/7-81-058) Avail: NTIS HC A25/MF A01 CSCL 10A

Detailed information is provided on coal production and employment by county, the consumption and distribution of coal, the ownership structure of the coal industry, coal land and mineral ownership, operator associations and unions in the coal industry, and projections of coal development. The emphasis is on the six ORBES states (Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia), but information also is provided on the coal industry in the other eastern states and the western states when relevant. GRA

N82-18790# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Applied Research Branch.

SITE INVESTIGATIONS AND SUBMARINE SOIL MECHANICS IN POLAR REGIONS

Edwin J. Chamberlain Oct. 1981 20 p refs Sponsored in part by Geological Survey

(AD-A108269; CRREL-SR-81-24) Avail: NTIS HC A02/MF A01 CSCL 08/13

Placing oil exploration and production structures offshore in the Alaskan Beaufort Sea will require careful site investigation and evaluation of submarine soil mechanics. Ice-bonded permafrost occurs widely under the Beaufort Sea floor. Its engineering properties are important to the design of offshore structures. Highly overconsolidated clays also occur widely and interfere with access to gravels for constructing artificial islands. Sites should be selected to avoid ice-rich permafrost. Laboratory tests may need to be conducted to determine the potential hazards of thaw consolidation and weakening. GRA

N82-18800# Geological Survey, Reston, Va.

ENVIRONMENTAL GEOLOGIC STUDIES ON THE SOUTHEASTERN ATLANTIC OUTER CONTINENTAL SHELF, 1977-1978 Final Open File Report

Peter Popenoe, ed. 1981 435 p refs

(Contract DI-AA551-MU8-13)

(PB82-109265; OPEN-FILE-81-582-A; BLM/YN/SR-81/02) Avail: NTIS HC A19/MF A01 CSCL 08G

The methods, techniques, instruments, and procedures utilized in accomplishing the study are summarized. The objectives were: (1) to determine the sedimentation rates and processes on the upper slope and inner Blake Plateau; (2) to determine the distribution, areal extent, and nature of geological features supportive of biological communities; (3) to monitor the transport of bottom sediments across the (OCS) Outer Continental Shelf; (4) to determine the concentration levels of chosen trace metals and silica; (5) to study the shelf edge and slope near areas of oil and gas interest; and (6) to determine the depth and rate of sediment mixing. Detailed results are given. GRA

N82-18840# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.

LONG RANGE LASER ANEMOMETRY WITH PARTICULAR REFERENCE TO WIND POWER DEVELOPMENT

L. Danielsson and E. R. Pike (Royal Signals and Radar Estab., Malvern, England) 6 Oct. 1981 51 p refs Submitted for publication

(Contract NE-5061-014)

(FFA-TN-HU-2262-Pt-3) Avail: NTIS HC A04/MF A01

Literature on atmospheric scattering of visible (Ar+) and IR (CO2) laser beams with transit time and Doppler processing was reviewed. A decision flow diagram for geometrical specifications of wind measurements and comparison tables are provided in order to show which system is best for any given task, e.g., wind generator interaction. When range resolution, flexibility, and economic requirements permit, an IR system is recommended. The economic advantages of time multiplexing are pointed out. Author (ESA)

N82-19319# Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (West Germany).

DEUTERIUM HYDROGEN ISOTOPE RATIOS IN ORGANIC MATTER, MINERAL OILS, AND NATURAL GASES Final Report, Mar. 1981

Martin Schoell Bonn Bundesministerium fuer Forschung und Technologie Nov. 1981 79 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-81-204; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 16.80

The dependence of the D/H isotope ratio in mineral oils and natural gases on the type of oil source rock and its usefulness for oil exploration were investigated. A technique was developed capable of determining D/H ratios in organic matter with an accuracy of + or - 2 pro mille. Results show that the isotope ratio in oils are indeed transferred by the mother rocks. Exchange experiments demonstrate that this ratio is not affected by exchange with water, even on geological time scales. The deuterium concentration in the methane of thermally formed natural gases is shown to be dependent on the maturity of the source organic matter, not on the type of mather rock. Cross correlation between the C14/C13 and the D/H ratios of natural gas methanes leads to a genetic diagram characterizing the origin of these gases. A criterium was also developed for the identification of bacterial natural gases. Author (ESA)

N82-19332 IEA Coal Research, London (England).

CHEMICAL DESULPHURISATION OF COAL

Geoffrey F. Morrison Jun. 1981 72 p refs

(ICTIS-TR-15; ISBN-92-9029-066-8) Copyright. Avail: Issuing Activity

The forms of organic and pyritic sulfur in coal and the chemical reactions these may undergo are assessed. Processes for the chemical cleaning of coal are described and evaluated, including wet oxidation, chlorinolysis, hydrothermal, microwave, and chemical comminution processes. The additional sulfur removed by chemical as compared to physical cleaning processes is insufficient to justify the additional complexity and cost of preparation. More research is required into the modes of occurrence and chemistry of sulfur in coal, particularly of organic sulfur, before the efficiency of the chemical cleaning of coal can be improved. Author (ESA)

N82-19383# Mathtech, Inc., Princeton, N. J.

IMPEDIMENTS TO ENERGY AND MATERIALS RECOVERY FACILITIES FOR MUNICIPAL SOLID WASTE Final Report

Ernest H. Manuel, Jr. and Fritz W. Efaw Sep. 1981 229 p refs Prepared in cooperation with Franklin Associates, Prairie Village, Kans.

(Contract EPA-68-03-2761)

(PB82-102302; EPA-600/2-81-181) Avail: NTIS HC A11/MF A01 CSCL 21D

The impediments to recycling municipal solid waste were studied. The eight facilities selected for indepth analysis represented a cross section of technologies, ownership types, geographical locations, and recovered products. None of the facilities were economical in the context of providing the least cost mode of disposal, and all eight facilities experienced net operating losses. A major impediment encountered by most of the facilities was competition from lower-cost landfills. GRA

N82-19384# Systems Technology Corp., Xenia, Ohio.

COAL: dRDF (DENSIFIED REFUSE DERIVED FUEL) DEMONSTRATION TEST IN AN INDUSTRIAL SPREADER STOKER BOILER. USE OF COAL: dRDF BLENDS IN STOKER-FIRED BOILERS, VOLUME 1 Final Report

Ned J. Kleinhenz Cincinnati, Ohio EPA Sep. 1981 146 p 2 Vol.

(Contract EPA-68-03-2426)

(PB82-100868; EPA-600/2-81-183-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 21D

Boiler performance and environmental feasibility when combusting densified forms of refuse derived fuels (dRDF) blended with coal and fired in a modern industrial spreader stoker-fired boiler are evaluated. The second phase of a two phase evaluation program is discussed. Phase 2 demonstration testing was conducted in a larger industrial spreader stoker boiler. In a period of 402 hours, 1702 tons of dRDF were co-fired with coal. An additional 231 hours of coal baseline testing was completed to provide a basis of comparison for the test results. GRA

N82-19385# Systems Technology Corp., Xenia, Ohio.

COAL: dRDF (DENSIFIED REFUSE DERIVED FUEL) DEMONSTRATION TEST IN AN INDUSTRIAL SPREADER STOKER BOILER. USE OF COAL: dRDF BLENDS IN STOKER-FIRED BOILERS, APPENDICES A, B, C AND D, VOLUME 2 Final Report

Ned J. Kleinhenz Cincinnati, Ohio EPA Sep. 1981 250 p refs 2 Vol.

(Contract EPA-68-03-2426)

(PB82-100876; EPA-600/2-81-184-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 21D

Boiler performance and environmental feasibility when combusting densified forms of refuse derived fuels (dRDF) blended with coal and fired in a modern industrial spreader stoker-fired boiler are evaluated. Phase 2 demonstration testing was conducted in a large industrial spreader stoker boiler. Site selection criteria, test data tables, formulae, and fuel evaluations are presented. GRA

N82-19606 IEA Coal Research, London (England).

HYDROLOGICAL PROBLEMS OF SURFACE MINING

Peter A. Wood Sep. 1981 102 p refs

(ICTIS-TR-17; ISBN-92-9209-079-X) Copyright. Avail: Issuing Activity

The physical aspects of the relation between hydrology and the surface mining of coal are reviewed. Surface and ground water are considered at the planning, extraction and restoration phases of mining. Aspects covered include the collection and handling of hydrologica data; the construction of river diversions; the control of runoff, erosion and sediment; problems of ground water and dewatering; and spoil bank hydrology. Mining hydrology interrelationships must be considered in order to ensure the efficient running of a surface mining operation while adequately protecting the environment. Author (ESA)

N82-19637*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LONGWALL GUIDANCE AND CONTROL DEVELOPMENT Final Report, 1974 - 1982

31 Jan. 1982 118 p refs

(Contract ET-75-I-01-9012)

(NASA-TM-82455) Avail: NTIS HC A06/MF A01 CSCL 08I

The longwall guidance and control (G&C) system was evaluated to determine which systems and subsystems lent themselves to automatic control in the mining of coal. The upper coal/shale interface was identified as the reference for a vertical G&C system, with two sensors (the natural backgound and the

sensitized pick) being used to locate and track this boundary. In order to insure a relatively smooth recession surface (roof and floor of the excavated seam), a last and present cut measuring instrument (acoustic sensor) was used. Potentiometers were used to measure elevations of the shearer arms. The intergration of these components comprised the vertical control system (pitch control). Yaw and roll control were incorporated into a face alignment system which was designed to keep the coal face normal to its external boundaries. Numerous tests, in the laboratory and in the field, have confirmed the feasibility of automatic horizon control, as well as determining the face alignment. S.L.

N82-19674*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE GEOTHERMAL PROBABILISTIC COST MODEL WITH AN APPLICATION TO A GEOTHERMAL RESERVOIR AT HEBER, CALIFORNIA

Lowell H. Orren, G. Michael Ziman, and Sue Campbell Jones 15 Dec. 1981 70 p refs

(Contracts NAS7-100; DE-AI03-79ET-37116)

(NASA-CR-168641; DOE/ET-37116/1; JPL-Pub-81-117) Avail: NTIS HC A04/MF A01 CSCL 10A

A financial accounting model that incorporates physical and institutional uncertainties was developed for geothermal projects. Among the uncertainties it can handle are well depth, flow rate, fluid temperature, and permit and construction times. The outputs of the model are cumulative probability distributions of financial measures such as capital cost, levelized cost, and profit. These outputs are well suited for use in an investment decision incorporating risk. The model has the powerful feature that conditional probability distribution can be used to account for correlations among any of the input variables. The model has been applied to a geothermal reservoir at Heber, California, for a 45-MW binary electric plant. Under the assumptions made, the reservoir appears to be economically viable. Author

N82-20022*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FUTURE FUELS AND ENGINES FOR RAILROAD LOCOMOTIVES. VOLUME 1: SUMMARY

S. G. Liddle, B. B. Bonzo, G. P. Purohit, and J. A. Stallkamp 1 Nov. 1981 41 p

(Contracts NAS7-100; DE-AI01-78CS-55151)

(NASA-CR-168642; JPL-Pub-81-101-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 13F

The potential for reducing the dependence of railroads on petroleum fuel, particularly Diesel No. 2 was investigated. Two approaches are studied: (1) to determine how the use of Diesel No. 2 can be reduced through increased efficiency and conservation, and (2) to use fuels other than Diesel No. 2 both in Diesel and other types of engines. Because synthetic hydrocarbon fuels are particularly suited to medium speed diesel engines, the first commercial application of these fuels may be by the railroad industry. B.W.

N82-20279# Ohio Univ., Athens. Dept. of Chemistry.

INVESTIGATIONS OF THE CHANGES OF COAL STRUCTURE OCCURRING DURING GASIFICATION Progress Report

P. R. Griffiths 26 Oct. 1981 21 p refs

(Contract DE-FG22-80PC-30210)

(DE82-002652; DOE/PC-30210/T2) Avail: NTIS HC A02/MF A01

The feasibility of the application of diffuse reflectance infrared Fourier transform (DRIFT) spectrometry to the study of gas/solid reactions was demonstrated. The high signal to noise ratio (SNR) allows application of Fourier self deconvolution routines to increase the spectra information content. The combination of DRIFT spectrometry and Fourier self deconvolution enables the study of the mechanism of coal reactions and catalytic reactions to provide more information. DOE

N82-20280# Department of Energy, Grand Forks, N. Dak. Energy Technology Center.

ANALYSES OF THE NORTHERN GREAT PLAINS PROVINCE LIGNITES AND SUBBITUMINOUS COALS AND THEIR ASH

S. A. Cooley Jul. 1981 139 p refs

(DE81-028366; DOE/GFETC/RI-81/2) Avail: NTIS HC A07/MF A01

A compilation of analyses of North Dakota and Montana low-rank coals (lignites and subbituminous coals) and of their ash extends the data base for these coals. Samples both from exploratory core drilling and from auger-drilling at operating mines were evaluated to obtain a wider distribution of data. Averages and standard deviations were calculated for North Dakota and Montana mines, and correlations were investigated for east-west locations depending on geographic ranges. Highest variability for both coals was in moisture and ash contents, with moisture- and ash-free analyses being relatively uniform for each. Composition of ash exhibited wide variability, especially in sodium and calcium contents. Sulfur contents were quite variable, but the average content was usually low. Within-mine variability was usually similar to that between mines. In the eastern Montana transitional area between lignite and subbituminous coals, special precautions in sampling are required to permit accurate classification from analyses. Despite care in selection of representative cores, core samples were indicated to be less uniform in analyses than auger-drilled samples obtained from the same mine. DOE

N82-20281# SRI International Corp., Menlo Park, Calif.

EXPLORATORY STUDY OF COAL-CONVERSION CHEMISTRY Final Report, 20 Sep. 1979 - 19 Mar. 1981

D. S. Ross, D. McMillen, W. Ogier, and Q. Nguyen 12 Aug. 1981 95 p refs

(Contract DE-AC22-79ET-14855)

(DE82-001104; DOE/ET-14855-19) Avail: NTIS HC A05/MF A01

The rates at which the strong carbon-carbon and carbon-oxygen central bonds in hydroxydiphenylmethanes and hydroxydiphenyl ethers are broken, under homogeneous conditions, in tetralin at 400°C, were examined by tautomerization to the weakly bonded keto forms followed by homolysis of the central bonds. These homogeneous decomposition mechanisms bear directly on the susceptibility of these linkages to homogeneously and heterogeneously catalyzed cleavage. Iron oxides, particularly Fe_3O_4, are effective and selective catalysts for these same cleavages. Relative catalyst effectiveness suggests that the mechanism of catalysis involves radical cation formation. The conversion of coal to benzene soluble coal products in CO/H_2O systems displays a dependence on the pH of the starting aqueous phase. The increase in conversion is paralleled by an increase in the reaction rate of the water gas shift reaction. Potassium or sodium salts of molybdate, dichromate, and permanganate were effective for coal conversion. The catalytic activity of these salts depends on the starting pH of the aqueous solution adjusted with dilute KOH or HCL solutions. It is indicated that despite the catalytic activity of metal oxyanions, the changes in conversion are large over small pH changes; plots of conversion versus initial pH are S-shaped curves similar to common titration curves. DOE

N82-20283# Virginia Commonwealth Univ., Richmond. Dept. of Chemistry.

SUPPORTED METAL CARBONYLS: NEW CATALYSTS FOR LIQUEFACTION OF COAL Semiannual Technical Report

G. A. Melson 1981 6 p ref

(Contract DE-AC22-81PC-41761)

(DE82-002659; DOE/PC-41761/T1) Avail: NTIS HC A02/MF A01

Supported metal catalysts prepared from carbonyls and both simple and complex oxides (zeolites) were prepared by a newly developed procedure. Results of characterization by a variety of spectroscopic techniques are presented. DOE

N82-20284# Lummus Co., Bloomfield, N. J.

INTEGRATED TWO-STAGE LIQUEFACTION PARAMETRIC STUDY Quarterly Technical Progress Report, 1 Oct. - 31 Dec. 1980

H. D. Schindler, J. M. Chen, and J. D. Potts (Cities Service Research and Development Co., Tulsa, Okla.) Aug. 1981 66 p

(Contract DE-AC22-79ET-14804)

(DE81-028756; DOE/ET-14804/T2) Avail: NTIS HC A04/MF A01

A research study on Catalytic Expanded Bed Hydroprocessing of coal extracts and the operation of an integrated Two-Stage Liquefaction process development unit was made. Equilibration of the recycle paste solvent was achieved. Three short contact time runs were made with equilibrium solvent. Conversions ranged from 88 to 95 percent at hydrogen consumptions of

0.41 to 2.40 percent of moisture, ash-free coal. Considerable hydrogen was transferred from the solvent to the coal. The recycle solvent contained 23 to 48 percent 8500 F+. The LC-Finin bottoms constituted about 70 percent of the recycle solvent. The deasher recovered 71 to 80.5 percent of the extract from the SCT unit. Ash concentrations of less than 0.10 percent in the recovered extract were achieved. Nitrogen concentrations in the distillate products were below 0.2 percent. Both the catalyst activity and the product quality were the highest obtained thus far in the hydrocracking of coal extracts. An overall yield structure was calculated, based on the results of this period. The distillate (C5-8500F) yield was 3.29 barrels per ton of moisture, ash-free coal at a hydrogen consumption of 4.78 percent based on MAF coal. DOE

N82-20285 California Univ., San Diego.
STUDIES IN SHOCK-TUBE SPECTROSCOPY, CHEMICAL REACTION RATES AND MECHANISMS, UTILIZATION OF LOW-BTU GASES, AND GEOTHERMAL ENERGY. 1: SHOCK-TUBE SPECTROSCOPY. 2: SHOCK-TUBE STUDIES OF CHEMICAL REACTION RATES AND MECHANISMS. 3: UTILIZATION OF LOW-BTU GASES. 4: VOLCANOES AS A SOURCE OF GEOTHERMAL ENERGY Ph.D. Thesis
Jules Michael Kline 1981 180 p
Avail: Univ. Microfilms Order No. 8125440

Correlation-absorption measurements of the (0,0) band of the NO photon system at 2250 A and emission measurements of the neutrino sub 3 fundamental of N2O at 4.52 microns are described. Use of a revised Voigt parameter for the NO photon bands, it is shown, leads to an increased value of f sub 00. Measurement of an off peak spectral absorption coefficient for an isolated spectral line using a laser light source is described. The observed temperature and pressure dependence of the spectral absorption coefficient of CH2O at the HeXe laser line is accounted for. Thermal decomposition of N2O behind reflected shock waves for 1685< or = T, deg K< or = 2560 are studied. CH2O pyrolysis and oxidation by N2O behind reflected shock waves for 1200< or = T, deg K< or = 2200 are studied. Measurements of induction times and post induction conversion rates for H2-containing low Btu gas mixtures are described. Burning rates, heat-release rates, induction times, specific burning times and specific reduced burning volumes are determined for mixtures typical of in situ shale oil retorting. The potential use of volcanoes as a source of geothermal energy is described. Dissert. Abstr.

N82-20327# Committee on Science and Technology (U. S. House).
SYNTHETIC FUELS DEVELOPMENT
Washington GPO 1981 118 p Hearing before the Subcom. on Energy Development and Applications and the Subcomm. on Investigations and Oversight of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., No. 33, 27 Jul 1981
(GPO-85-050) Avail: Subcomm. on Energy Development and Applications

Recent developments in synthetic fuels technology are discussed, particularly in the areas of coal gasification, coal liquefaction, shale oil extraction, and alcohol fuel development. Government-industry cooperation is discussed. The problems of synfuel development are evaluated in the context of the U.S. dependence on imported oils. Synfuel production costs are examined. R.J.F.

N82-20332# SRI International Corp., Menlo Park, Calif.
FEASIBILITY STUDY ON NEW PROCESSES FOR FUEL FROM BIOMASS Summary Report, 1 Jun. 1979 - 31 Jan. 1981
D. Z. Rogers, Donald J. Wilhelm, and David S. Ross Jan. 1981 94 p refs Prepared for Pacific Northwest Lab.
(Contract DE-AC03-79ET-23023; SRI Proj. PYU-8616)
(DE82-002834; DOE/ET-23023/T4) Avail: NTIS
HC A05/MF A01

The technical and economic feasibility of producing liquid fuels from biomass by two types of proposed processes, peroxidic conversion and catalyzed direct liquefaction in a carbon monoxide/steam system was studied. The work was divided into three tasks: peroxidic conversion; novel acid/base systems; and economic evaluations. The plant capacity and design and economic bases were chosen to facilitate comparison with the LBL and PERC process concepts previously evaluated for DOE by SRI. This evaluation was cast in the same light as SRI's recent evaluation for DOE of the Albany liquefaction program. The product still appears to be a crude, complex, viscous, and troublesome material that could not be marketed, even as a low-grade fuel, because it is too costly and not an economical chemical feedstock. Catalytic direct biomass liquefaction still appears to offer little potential for commercialization. Economically feasible direct biomass liquefaction will require significant breakthrough in catalyst technology. Implications for research aimed at improving the liquefaction data base and the understanding of possible liquefaction processes are also discussed. GRA

N82-20333# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
METHANE UTILIZATION FROM COALBEDS FOR POWER GENERATION AT BETHLEHEM MINES CORPORATION MARIANNA MINE NO. 58 Final Report
May 1981 215 p refs
(Contract DE-AC21-77ET-13133)
(DE81-029791; AESD-TME-3065) Avail: NTIS
HC A02/MF A01

During one process of mining coal, methane is removed from the coal seam before the coal is mined. This methane is collected underground, piped to the surface, and exhausted to the atmosphere as a waste by-product of the mining process. An electrical power generation system was assembled to demonstrate utilization of this energy source. An 800 kW gas turbine generator with attendant compression and electrical equipment converted 200,000 standard cubic feet per day of methane to about 250 kWh. This electrical power was utilized by a mine surface load consisting of a 100 hp air compressor and a 300 hp mine ventilation fan. Power generated represented about 25% of the total energy used in all the mine ventilation systems or about 5% of the total underground mine electrical requirements. The main conclusions of the work performed is that low Btu gob gas in the range of 100 to 400 Btu/ft(3) can be combusted successfully in a diffusion flame system. The efficiencies that can be achieved are high and in general stability is adequate. Both the efficiency and stability range achieved were sufficient to indicate that a gas turbine could be operated with such fuels over a normal operating cycle. One problem that was noticed during earlier investigations is that because of the low energy content of the fuel, heat losses in the combustor can significantly affect performance, particularly stability. In general such combustion systems should be maintained as near adiabatic as possible and should operate with as high a wall temperature as is possible. Further research and development will be required of any scaled combustion system before it could be considered a suitable candidate for engine installation. S.L.

N82-20334# West Virginia Univ., Morgantown. Dept. of Chemical Engineering.
ROLE OF C-CO2 IN GASIFICATION OF COAL AND CHAR Quarterly Report, 1 Jan. - 31 Mar. 1981
J. T. Sears and C. Y. Wen 1981 16 p refs
(Contract DE-AC21-78ET-11338)
(DE81-027358; DOE/ET-11338/T1) Avail: NTIS
HC A02/MF A01

The high-temperature TGA has been operated with steam and CO2 for lignite and bituminous chars. Problems with temperature calibration require varification of results before further analysis. Work on attrition of coal in a pressurized, sand fluid-bed was completed. Conditions were 5-45 cm/sec at 1 to 7 atm total pressure. The rate obtained increases with fluidizing velocity and pressure. The rate constants are negligible at velocities below approx. = 30 cm/sec for particles 60 to 175 (SIGMA) in diameter. Results appear to be dependent on change in hydrodynamics with pressure. A hot-bed fluidization system was commissioned and operated. Entrainment/elutriation data for coal particles was obtained in the range 5 to 90 cm/sec at 800 to 9000C for a 12.7 cm sand bed. DOE

N82-20335# Battelle Columbus Labs., Ohio.
SYNTHETIC-FUEL AROMATICITY AND STAGED COMBUSTION Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981
Arthur Levy, James R. Longanbach, and Lisa K. Chan 31 Oct. 1981 24 p
(Contract DE-AC22-89PC-30302)
(DE82-002453; DOE/PC-30302/4) Avail: NTIS
HC A02/MF A01

Synthetic liquid fuels, synfuels or coal-derived liquids were characterized from a combustion-environmental point of view. Two critical problems, NO/sub x/ formation and soot formation

were studied. Pyrolysis of SCRII cuts in helium resulted in increasing aromatization as the temperature was increased. This occurred with substantial losses of hydrogen, although the amount of aromatic hydrogen per molecule increased. The slight decrease in carbon content and loss of hydrogen were balanced by a relative increase in heteroatom content, presumably oxygen. This resulted in large concentrations of unsubstituted aromatics n the stable liquid products. These were presumed to be soot precursors in staged combustion. Nonbasic nitrogen, primarily pyroles, were found to increase during pyrolysis, while basic nitrogen, primarily pyridine analogs, decreased. Thus, nonbasic nitrogen compounds could be the principal precursors of NO/sub x/ during staged combustion of synthetic coal derived fuels. When substoichiometric amounts of oxygen were added to the system, aromaticity increased.
M.D.K.

N82-20336# Dravo Corp., Pittsburgh, Pa.
FEASIBILITY STUDY FOR THE PRODUCTION OF LOW/MEDIUM-Btu GAS FROM COAL FOR TRI-CITY REGIONAL PORT DISTRICT GRANITE CITY, ILLINOIS
Feb. 1981 313 p
(Contract DE-FG01-80RA-50137)
(DE82-002881; DOE/RA-50137/1) Avail: NTIS HC A14/MF A01

The technical specifications for, and the economic feasibility of a wide variety of coal gasification facilities to meet the needs of an industrial park are described. The gasification facility is aimed at making the industrial sites energy independent. Three cases were studied, and the results of each are presented. The cost of gas for each case was determined both at the facility, and as delivered. The projected fuel cost for coal gas in the minimum capacity plant is considerably less than the cost for fuel oil.
DOE

N82-20474# Air Products and Chemicals, Inc., Allentown, Pa.
GAS/SLURRY FLOW IN COAL LIQUEFACTION PROCESSES (FLUID DYNAMICS IN 3-PHASE FLOW COLUMNS) Quarterly Technical Progress Report, 1 Oct. - 31 Dec. 1980
David H. S. Ying, R. Sivasubramanian, and Edwin N. Givens
Feb. 1981 41 p refs
(Contract DE-AC22-79ET-14801)
(DE82-002562; DOE/ET-14801/15) Avail: NTIS HC A03/MF A01

The need for additional data on behavior of three phase systems in large vessels was addressed. Parameters are investigated at conditions that relate directly to the projected demonstration plant operating conditions. Air/water/sand three phase flow system in both a 5 inch diameter and a 12 inch diameter column is used in this cold flow simulation program. The type of distributor used does not seem to affect the solids distribution profiles. The amount of solids retained in the column increases linearly with decreasing slurry velocity while changes in linear gas velocity does not affect the solids distribution profiles for the conditions studied. It is indicated that withdrawing solids from the bottom of the column results in a decreased amount of solids in the column and the solids concentration profile changes accordingly. It is shown that large particles were preferentially removed by virtue of their faster settling rate. The effects of settled particles and particle/particle interaction on solids accumulation were investigated. It it indicated that the presence of large particles does not influence the accumulation or distribution of fine particles. The column enclosure was completed and tested to identify the organic liquid/liquid which is to be used in the 12 inch diameter column.
DOE

N82-20492# Argonne National Lab., Ill. Components Technology Div.
DEVELOPMENT AND TESTING OF HIGH-TEMPERATURE ACOUSTIC DOPPLER FLOWMETER
H. B. Karplus, A. C. Raptis, and D. R. Canfield (Pittsburgh and Midway Coal Mining Co.) Sep. 1981 35 p refs
(Contract W-31-109-eng-38)
(DE82-003013; ANL/FE-81-64) Avail: NTIS HC A03/MF A01

The development and testing of an acoustic Doppler flowmeter are discussed. The characteristics of this flowmeter are: (1) standoffs to isolate the transducers from the hot pipes; and (2) an electronics system with servo-controlled adjustable filters that can process a Doppler-shift signal spectrum generated by laminar flow conditions. Flowmeters are adapted to high-temperature and high-viscosity laminar flow streams found in coal liquefaction plants.
DOE

N82-20632# Management Engineers, Inc., Reston, Va.
ROOM AND PILLAR RETREAT MINING: A MANUAL FOR THE COAL INDUSTRY
Peter W. Kauffman, Steven A. Hawkins, and Robert R. Thompson
Aug. 1981 240 p refs
(PB82-120601; BM-IC-8849) Avail: NTIS HC A11/MF A01 CSCL 08I

This Bureau of Mines publication is designed 'primarily to provide mine engineers and production-level mine managers with the following: (1) information to assist them in making the decision to retreat mine and in selecting the best retreat mining technique for specific mining conditions; (2) information on mine planning that will enable them to design mine layouts for safe and efficient retreat mining (3) information that will enable them to develop a section foreman's handbook. The manual progressively increases in level of detail.
GRA

N82-20680# EMCON Associates, San Jose, Calif.
STATE OF THE ART OF LANDFILL GAS RECOVERY
John Pacey, David Armstron, Costa Halvadakis, Gail Karpinski, and Marya Donch Jul. 1981 117 p refs Prepared for Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE82-003261; ANL/CNSV-TM-85) Avail: NTIS HC A06/MF A01

Optimization of methane recovery from landfills involves management of the physical and reclaimed factors associated with extraction of the gas. The technology of gas-recovery enhancement is rapidly evolving and is linked closely with numerous site-specific variables. The state-of-the-art study describes the most common recovery-system techniques and methodologies, and operates some promising alternative methods that can affect future recovery designs and mathematical models. Gas extraction characteristics are summarized for eight on-line and pending systems.
DOE

N82-20695# Acurex Corp., Mountain View, Calif. Energy and Environmental Div.
ADVANCED PULVERIZED-COAL COMBUSTOR FOR CONTROL OF NO SUB x EMISSIONS Quarterly Report, 1 Jul. - 30 Sep. 1981
R. L. Pam, S. T. Suttmann, and J. T. Kelly 30 Oct. 1981 13 p refs
(Contract DE-AC22-80PC-30296)
(DE82-002653; DOE/PC-30296/4; QR-4) Avail: NTIS HC A02/MF A01

The program uses an idealized one-dimensional combustor, incorporating fuel staging. The development of a comprehensive computer model which allows NO mechanisms and rates to be extracted from the experimental data, is reported. A coal devolatilization model was developed and integrated into the PROF code. Combustor curing and facility build up was completed.
T.M.

N82-20696# Brookhaven National Lab., Upton, N. Y.
CALCIUM SILICATE CEMENTS FOR DESULFURIZATION OF COMBUSTION GASES Semiannual Progress Report, 1 Oct. 1980 - 31 Mar. 1981
H. J. Yoo, P. J. McGauley, M. Steinberg, G. Farber, F. B. Kainz, and J. Pruzansky Jun. 1981 46 p refs
(Contract DE-AC02-76CH-00016)
(DE82-003245; BNL-51430) Avail: NTIS HC A03/MF A01

Commercial calcium silicate bearing Portland Cement Type II (PC III) was identified as a promising regenerative sorbent for the removal of sulfur in the fluidized-bed combustion (FBC) of coal. The PC III is agglomerated in a drum pelletizer by low energy, low cost agglomeration techniques and cured to form pellets in the size range suitable for operating FBC units. The degree of regeneration is almost complete (above 95%) during cyclic use except for the first cycle. The rate of sulfation increases with the sulfation temperature. The rate of regeneration also increases with the regeneration temperature. A small 40 mm I.D. bench scale fluid bed reactor was used to determine the sulfur removal efficiency of the PC III pellet as well as the concentration of the regenerated SO2, using propane gas as a fuel and a reducing agent. The concentration of regenerated SO2 increases with the feed rate of reducing gas and it reaches as high as 24%. Bench scale testing of PC III sorbent in a coal

fired 6 in. fluidized bed combustor indicates acceptable performance. An improved process and engineering design utilizing the PC III pellets in a coal fired power plant indicates improved economy in comparison with once through limestone desulfurization. DOE

N82-20697# TRW, Inc., Redondo Beach, Calif.
EVALUATION OF CONTINUOUS OXYDESULFURIZATION PROCESSES Final Technical Report, Sep. 1979 - Jul. 1981
J. F. Jones and D. M. Wever Jul. 1981 106 p
(Contract DE-AC01-79ET-14292)
(DE82-002127: DOE/ET-14292/T1) Avail: NTIS
HC A06/MF A01

Three processes for the oxydesulfurization of coal were evaluated in continuous processing equipment designed, built, and/or adapted for the purpose. The three processes differed primarily in the chemical additives (none, sodium carbonate, or ammonia), fed to the 20% to 40% coal/water slurries, and in the oxygen content of the feed gas stream. Temperature, pressure, residence time, flow rates, slurry concentration and stirrer speed were the other primary independent variables. The amount of organic sulfur removed, total sulfur removed and the Btu recovery were the primary dependent variables. DOE

N82-20698# Ames Lab., Iowa.
ADVANCED RESEARCH AND TECHNOLOGY DIRECT UTILIZATION: RECOVERY OF MINERALS FROM COAL FLY ASH. FOSSIL ENERGY PROGRAM Technical Progress Report, 1 Apr. - 30 Jun. 1981
G. Burnet, J. W. Dunker, and M. J. Murtha Sep. 1981 41 p refs
(Contract W-7405-eng-82)
(DE82-003133; IS-4777) Avail: NTIS HC A03/MF A01

The purpose of this research is to develop methods to process fly ash for (1) the separation and use of an iron rich fraction; (2) the recovery of metals (primarily Al, Fe, and Ti); and (3) the use of the process residues. During this report period, research on the HiChlor process for the high temperature chlorination of fly ash included investigation of prechlorinations using Cl2CO gas mixtures to selectively remove iron and titanium, and the physical characterization of fly ash pellets. Gas diffusion coefficients, surface areas, and pore size distributions were measured for both gamma-alumina and fly ash pellets. Experiments on the high temperature sintering of limestone-fly ash mixtures include alumina extractions from sinters prepared using waste materials. High alumina recoveries were obtained for sinters prepared using cement kiln dust as the lime source, and withsmall amounts of coal refuse added as a mineralizer. Sinter feed mixtures prepared from fly ash, kiln dust, and soda ash were also tested. X-ray diffraction measurements were used to identify the soluble and insoluble compounds found in the clinkers produced. Research has been initiated on methods to agglomerate fly ash mixtures for processing. Agglomerators rather than finely divided powder mixtures will be more easily handled, transported and processed. Feed mixtures for both the lime sinter and the HiChlor processes are being studied. A balling disc unit is being used to form agglomerate spheroids. A theoretical analysis of the magnetic separation of fly ash has been completed. GRA

N82-20779 Technische Hochschule, Hanover (West Germany). Inst. fuer Meteorologie und Klimatologie.
WIND MEASUREMENTS FROM 50 M HIGH TOWERS IN THE NORTHERN GERMAN COASTAL REGION [WINDMESSUNGEN AN 50 M HOHEN TUERMEN IM NORDDEUTSCHEN KUESTENGEBIET]
G. Tetzlaff, R. Beyer, and H. Laude *In* Deutscher Wetterdienst Soc. Meteorol. Palatina, 1780-1795 1980 p 174-176 refs In GERMAN; ENGLISH summary

Avail: Issuing Activity

Wind profiles based on measurements with a network of six 46 m high towers in northern Germany are described. Wind measurement is only satisfactory if the relevant parameters, such as roughness length and stability are fully known as a function of wind direction and wind speed. Only then the error of extrapolated wind speed values is acceptable for application in wind energy. E.A.K.

N82-21111# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A PROCEDURE FOR DETERMINING THE RESOURCE UTILIZATION POTENTIAL OF COAL ASH M.S. Thesis
James F. Karasek Sep. 1981 140 p refs
(AD-A109877: AFIT-LSSR-58-81) Avail: NTIS
HC A06/MF A01 CSCL 21/2

A combination of the increased utilization of coal as an energy source and more stringent environmental regulations is creating problems for the disposal of the ash by-product from the combustion of coal. Utilization of the coal ash as an alternate resource has proven to be a partial solution to the problem. The U.S. Air Force coal conversion program will increase coal consumption and the production of coal ash; this has a potential to create a disposal problem for coal-burning bases. The purpose of this thesis was to develop a procedure to aid an engineer in determining the resource utilization potential of the coal ash at the base. The quality and quantity of the ash are the two main factors that affect the resource utilization potential of the ash. These two factors are a function of the nature of the feed coal, and the production, collection, handling, and storage systems utilized at the base. The procedure does not address the determinstion of the market potential of the ash, but rather its potential to be utilized as an alternate resource. The procedure provides a sequence of steps to follow in determining the resource utilization potential of a coal ash. Author (GRA)

N82-21279# Otisca Industries Ltd., Syracuse, N.Y.
HEAVY-LIQUID BENEFICIATION OF FINE COAL Quarterly Report, 1 Apr. - 30 Jun. 1981
D. V. Keller, Jr. and Frederick J. Simmons Jul. 1981 37 p refs
(Contract DE-AC22-80PC-30139)
(DE81-030965: DOE/PC-30139/T2: QR-3) Avail: NTIS
HC A03/MF A01

This reporting period was devoted to the development of the rheological data for the coal/Freon-113 particle size, density, and percent solids matrix. Preliminary rheological data have also been obtained for the coal-water-magnetite slurry system. The evaluation of this system will continue into the Fourth Quarter. Sufficient rheological data were obtained so that the design criteria for the bench scale cyclone test facility was developed. The design effect for bench scale cyclone test facility was completed and a preliminary design proposal submitted to DOE on July 21, 1981. DOE

N82-21280# Solar Turbines International, San Diego, Calif.
MECHANISMS OF FOULING, SLAGGING, AND CORROSION BY PULVERIZED-COAL COMBUSTION Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981
L. L. Hsu, A. R. Stetson, and A. G. Metcalfe Oct. 1981 40 p ref
(Contract DE-AC22-81PC-40272)
(DE82-001661: DOE/PC-40272/T2: SR-81-R-4930-08: QTPR-2) Avail: NTIS HC A03/MF A01

The objective of this program is to conduct a detailed and comprehensive study of the mechanisms of fouling slagging, and corrosion in pulverized coal combustion by employing well controlled model systems which simulate the coal combustion environment. In the second quarter, work focused on completing construction of the test rig. Meanwhile, the combustor and fuel nozzle were redesigned to allow for introduction of particulates and salt solution through the fuel nozzle. Fabrication of the modified combustor and fuel nozzle is complete. The completed test system will allow particles and salt droplets to flow through the combustion zone prior to impingement on the specimen tubes. Construction of specimen retort for furnace testing is complete. Plans for the next quarter are to install and calibrate the combustor rig. DOE

N82-21281# Virginia Commonwealth Univ., Richmond. Dept. of Chemistry.
NEW CATALYSTS FOR THE INDIRECT LIQUEFACTION OF COAL Annual Technical Report, 1 Aug. 1980 - 31 Jul. 1981
G. A. Melson 1981 10 p
(Contract DE-FG22-80PC-30229)
(DE82-000892: DOE/PC-30228/T2) Avail: NTIS
HC A02/MF A01

The synthesis, characterization and evaluation of catalytic activity for synthesis gas conversion of some supported metal catalysts were achieved during the period of grant support. These catalysts are significantly different from those obtained by

conventional synthetic procedure and results in different product distributions when used for synthesis gas conversion. DOE

N82-21282# Energy and Environmental Research Corp., Santa Ana, Calif.
SOOT FORMATION IN SYNTHETIC-FUEL DROPLETS Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981
G. England, J. Kramlich, Y. Kwan, and R. Payne 30 Nov. 1981 32 p refs
(Contract DE-AC22-80PC-30298)
(DE82-004257; DOE/PC-30298/T4; QTPR-4) Avail: NTIS HC A03/MF A01

The droplet effects on particulates, smoke, and NO sub x emissions using the variable spray momentum injector under normal excess air and staged combustion conditions was investigated. A total of four fuels were tested, including an SRC-II blend with middle and heavy distillate. Test results indicated that within the range of droplet sizes and injection velocities investigated, particulate emissions are not strongly dependent upon droplet parameters. The greatest effect was observed for relatively large droplets (500 microns) in regions of low slip velocity. The flame studies research was concentrated upon the completion of the droplet experiments. Microexplosions of individual droplets, oil-coke cenosphere formation for residual fuel oil, and violet secondary atomization of droplets blended from heptane and heavy synthetic fuel oil were observed. At fuel rich conditions, droplet soot was correlated with carbon/hydrogen ratio for a number of fuels. The coupling between the thermal and chemical processes within the soot formation region, the morphology of the soot, and visualization of individual droplet combustion were also studied. DOE

N82-21283# Weber State Coll., Ogden, Utah. Dept. of Chemistry.
ROLE OF THE HYDROGEN DONOR SOLVENT IN COAL HYDROLIQUEFACTION Progress Report, 1 Dec. 1980 - 28 Feb. 1982
R. R. Beishline 15 Oct. 1981 15 p refs
(Contract DE-AC02-79ER-10510)
(DE82-002716; DOE/ER-10510/T3) Avail: NTIS HC A02/MF A01

A free radical mechanism has been written for the thermolysis of the donor solvent intermediate 1,2-dihydronaphthalene (1,2-DHN). The initiation step (E/sub a/ about 38 kcal/mole) is a disproportionation between two molecules of 1,2-DHN to produce hydronaphthyl and tetralyl radicals. These radicals attack 1,2-DHN to produce dimers, or form naphthalene, tetralin and H., principally by disproportionation. The previously unknown structures of the dimers have been determined and are consistent with the proposed mechanism. The mechanism is also consistent with the experimentally measured kinetics, i.e., disappearance of 1,2-DHN by concurrent first and second order reactions. The observed first and second order rate constants are complex composites of the rate constants for the individual steps in the mechanism. Semiquantitative measurements show that molecular hydrogen is about 10% of the reaction product at 4500 C. When polycyclic aromatic hydrocarbons (PAH) are heated with 1,2-DHN, the amount of hydrogen evolved is approximately inversely proportional to the resonance energy of the PAH, i.e., the H addition: abstraction ratio increases with increasing stability of the potential hydroaromatic radical. A quantitative procedure for measuring hydrogen is being developed for future use in determining relative rates of H addition vs abstraction. DOE

N82-21298# Carltech Associates, Columbia, Md.
TECHNICAL FEASIBILITY OF USE OF EASTERN GEOTHERMAL ENERGY IN VACUUM DISTILLATION OF ETHANOL FUEL EXTENSION OF DATA
J. Carl Uhrmacher Sep. 1981 19 p refs
(Contract EX-78-A-38-1008)
(PB82-127077; JHU/APL/OM-81-123) Avail: NTIS HC A02/MF A01 CSCL 07A

The feasibility of vacuum distillation of ethanol fuel with modest temperature geothermal resources is discussed. The flow rates of geothermal water at 155 F are documented as a function of beer-still bottoms pressure. Emphasis is on pressures that are less than 150 mmHg. T.M.

N82-21416# Materials Research Labs., Melbourne (Australia).
HYDROCRACKING OF THE OILS OF BOTRYOCOCCUS BRAUNII TO TRANSPORT FUELS
L. W. Hillen, G. Pollard, L. V. Wake, and N. White Jul. 1980 23 p refs
(MRL-R-783; AR-002-170) Avail: NTIS HC A02/MF A01

Hydrocarbon oils of the alga Botryococcus braunii, extracted from a natural 'bloom' of the plant, were hydrocracked to produce a distillate comprising 67% a petrol fraction, 15% an aviation turbine fuel fraction, 15% a diesel fuel fraction, and 3% residual oil. The distillate was examined by a number of standard petroleum industry test methods. This preliminary investigation indicates that the oils of B. braunii are suitable as a feedstock material for hydrocracking to transport fuels. Author

N82-21424# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.
THE EFFECT OF FUEL COMPOSITION ON GROUNDFALL FROM AIRCRAFT FUEL JETTISONING Final Report, Mar. 1980 - Feb. 1981
Harvey J. Clewell, III Mar. 1981 35 p refs
(AF Proj. 1900)
(AD-A110305; AFESC/ESL-TR-81-13) Avail: NTIS HC A03/MF A01 CSCL 01/3

A computer model which simulates the evaporation and free-fall of fuel droplets in the atmosphere was used to determine the effect of fuel composition on the nature and extent of ground contamination by fuel discharged from an aircraft in flight. Three fuel compositions were used: (1) JP-4, the standard Air Force jet fuel; (2) Jet A (JP-8), the standard U.S. commercial jet fuel; and (3) Number 2 Diesel Fuel, representing the upper limit for future, broadened-specification fuels from alternative sources. The results of this study indicate that the amount of liquid fuel reaching the ground from the jettisoning of commercial jet fuels is much greater than for JP-4. Moreover, future broadened specification fuels may produce even greater ground contamination when jettisoned. GRA

N82-21426# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
EVALUATION OF THE EFFECTS OF ALCOHOL FUELS ON SPARK IGNITION ENGINE WEAR Final Report, Sep. 1979 - Sep. 1981
H. W. Marbach, Jr., E. C. Owens, T. W. Ryan, III, E. A. Frame, and D. W. Naegeli Dec. 1981 115 p refs
(Contracts DAAK70-79-C-0175; DE-AI01-79CS-50030)
(AD-A110021; AFLRL-150) Avail: NTIS HC A06/MF A01 CSCL 21/7

An investigation of the effects of alcohol fuels on spark ignition engine wear and deposition was jointly sponsored by the U.S. Department of Energy and the U.S. Army Mobility Equipment Research and Development Command. Tests were conducted using neat methanol, anhydrous ethanol, and alcohol blends as fuel in a 2.3 liter engine using a modified ASTM Sequence V-D test procedure. This dynamometer testing indicates that alcohol fuels reduce the buildup of engine deposits. Also, it was found that neat methanol greatly increases engine wear rates at operating temperatures below 75 C, while anhydrous ethanol and alcohol-gasoline blends do not increase wear rates over that of unleaded gasoline. Tests were then conducted to evaluate the effects of methanol fuel on ten fully formulated lubricants and one lubricant with twelve additive composition changes. A 20 hour steady-state test was developed which shows that engine wear is inversely related to engine oil temperature when using methanol as fuel. The study shows that one lubricant appears to best control methanol-related engine wear, but still not to acceptable levels. GRA

N82-21427# Reinke (Ralph G.), Wausau, Wis.
DISTILLING ALCOHOL WITH WASTE AUTOMOBILE HEAT Progress Report
Ralph G. Reinke 26 Apr. 1981 19 p
(Contract DE-FG02-81AF-92017)
(DE82-000143; DOE/AF-92017/T1) Avail: NTIS HC A02/MF A01

A device that will utilize the waste heat of an automobile for the production of alcohol fuel and provide a means for an individual without the land or resource of an agricultural facility to have the capability of producing alcohol is discussed. The method involves piping the radiator cooling fluid through a heat exchanger constructed to serve as a distillation unit. The technical description, financial report, administration report, and problems and remedies are presented. DOE

N82-21429# Nuclear Assurance Corp., Atlanta, Ga.
FEASIBILITY STUDY OF THE COMMERCIAL PRODUCTION OF ETHANOL FROM WOOD. VOLUME 2: APPENDICES 1-6 Final Report
Jun. 1981 706 p refs 2 Vol.
(Contract DE-FG07-80RA-50322)
(DE82-002410; DOE/RA-50322/T1-Vol-2) Avail: NTIS
HC A99/MF A01

The development of a 25 million gallon per year ethanol plant which uses cull timber wood as feedstock is discussed. The individual reports from each subcontractor involved in the investigation are given. Included is feasibility study for fuel grade ethanol plant and reports on wood residues, biomass, and other wood fuel data. A market analysis, hydrolysis of biomass, and an alternate site evaluation and community impact assessment are included. DOE

N82-21430# North Central Consultants Ltd., Jamestown, N. Dak.
FEASIBILITY STUDY FOR ALTERNATE FUEL PRODUCTION FROM BIOMASS RESOURCES
Jun. 1981 260 p Prepared in cooperation with Katzen (Raphael) and Associates and Touche, Ross and Co.; prepared for Dawn Enterprises, Inc.
(Contract DE-FG07-80RA-50361)
(DE82-002616; DOE/RA-50361/T1) Avail: NTIS
HC A12/MF A01

A 50 mm anhydrous alcohol plant is described. The plant uses barley grown in the region as the raw material to produce a motor fuel grade alcohol through a fermentation and distillation process. North Dakota lignite coal is used as the primary energy sources to produce alcohol from the barley. The site is located on an active branch of the Burlington Northern Railroad, providing efficient and economical access to North Dakota's vast lignite coal fields in western North Dakota and to the established grain and grain by-product markets of Duluth and Minneapolis. The site is also adjacent to paved secondary highways, providing access to state and interstate highway systems. The plant site is adjacent to the City of Walhalla and will be annexed to the city limits and served by community facilities. Electrical energy to operate plant equipment is partially produced by co-generation within the plant but the total electrical energy cannot be produced internally. A technical review of the plant is provided. The process, plant layout, and major equipment procurement and costs are described. A complete economic analysis is provided using the data derived from the technical evaluation and cost estimates. Siting and the environmental and socio-economic considerations are covered. A review of the proposed management and personnel structure is included. DOE

N82-21432# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
SMALL-SCALE FUEL-ALCOHOL PLANT. VOLUME 1: DESIGN REPORT
Aug. 1981 227 p
(Contract DE-AC07-76ID-01570)
(DE82-001038; DOE/TIC-2001038-Vol-1) Avail: NTIS
HC A11/MF A01

A small-scale fuel alcohol plant designed and constructed for the DOE by EG and G Idaho, Inc., an operating contractor at the Idaho National Engineering Laboratory, is described. The plant is reasonably complete, having the capability for feedstock preparation, cooking, saccharification, fermentation, distillation, by-product dewatering, and process steam generation. An interesting feature is an instrumentation and control system designed to allow the plant to run 24 hours per day with only four hours of operator attention. The production designed capacity of the plant is 26.4 gallons of 190-proof ethanol per hour. Most of the processes and equipment used in the plant represent conventional ethanol production technology. Two slight deviations are the control system, which is common in larger plants, and the continuous cooker, which was adapted from the food industry. A device for dewatering the by-product is included, but a by-product drying system was not, because systems evaluated were too expensive for a plant of this size. DOE

N82-21435# Bethlehem Steel Co., Pa.
COAL-GASIFICATION STUDY FOR BETHLEHEM STEEL CORPORATION'S SPARROWS POINT FACILITY
Aug. 1981 29 p
(Contract DE-FG01-79RA-20218)
(DE82-002570; DOE/RA-20218/1) Avail: NTIS
HC A03/MF A01

Although processes for producing environmentally acceptable gas from coal are available commercially, the lack of commercial operating experience in the United States requires that the pioneer users principally rely on engineering and economic analysis. The uncertainty of costs, operating reliability and retrofit impacts as well as many other factors are all considerations which must be weighed seriously when considering the use of low/or medium-Btu coal gas as an alternative fuel option. Financial analysis of the coal gasification project for Sparrows Point was done. The packback period ranged from 6.9 to 15.7 years for air-blown gasification. Oxygen-blown gasification was not at all attractive. It showed a 20.7 year payback at the most favorable end of the range. Two factors affect whether a steel plant will install coal gasification - availability of purchased fuels and economics. There is little incentive to make large capital expenditures when plentiful quantities of purchased fuels are available. Based on economics, coal gasification cannot be justified. DOE

N82-21436# American Association of Community and Junior Colleges, Washington, D.C. Energy Communications Center.
ALCOHOL FUELS PRODUCTION, MANPOWER, AND EDUCATION: WHERE DO TWO-YEAR COLLEGES FIT
1981 37 p refs
(Contract DE-FG05-79IR-10295)
(DE82-001929; DOE/IR-10295/T1) Avail: NTIS
HC A03/MF A01

Representatives from 2-year colleges met with officials from national organizations to discuss the role of community colleges in the training of personnel and the development of curriculum to enhance the growing alcohol fuels industry. Major conclusions include: (1) Energy issues are too important for colleges to ignore in their program offerings; each college should determine what energy focuses and what program forms make most sense for its local area; (2) Community-size alcohol plants have the potential of leading the way toward local economic development and self sufficiency; (3) Production and manpower projections vary widely from one source to another. Even if the most optimistic production levels are reached, the evidence shows that three will be only a modest need for narrowly-trained alchol fuels technicians. The most reasonable approach for colleges is to train energy generalists through curricula that focus on basic competencies in science, math, management, and communications. DOE

N82-21437# Pittsburg and Midway Coal Mining Co., Shawnee Mission, Kans.
RESEARCH ON SOLVENT-REFINED COAL Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981
Oct. 1981 139 p refs
(Contract DE-AC22-81PC-40005)
(DE82-002530; DOE/PC-40005/5) Avail: NTIS
HC A07/MF A01

Research progress on Solvent Refined Coal is reported. Alexander Mine coal was evaluated as a feedstock for major liquefaction facilities and had a yield structure similar to other reactive Pittsburgh seam coals at standard SRC II conditions. Two lots of coal from the Ireland Mine (Pittsburgh seam) were found to be of nearly the same composition and produced essentially the same yields. Two experiments in which coal-derived nonvolatile organic matter was processed without fresh coal feed indicated constant rates of conversion of SRC to oil and gas. Insoluble organic matter remained unconverted. The naphtha and middle distillate products from the deep conversion contained less sulfur but more nitrogen than those from conventional SRC II processing. Encouraging results were obtained when a very small amount of iron oxide dispersed on alumina was added to Kaiparowits coal which cannot be proposed at normal SRC II conditions without added catalyst. Subbituminous coals from the McKinley and Edna Mines were processed successfully with added pyrite but would not run when the added catalyst was removed. DOE

N82-21439# Environmental Protection Agency, Ann Arbor, Mich. Control Technology Assessment and Characterization Branch.
A REVIEW OF THE COMPATIBILITY OF METHANOL/GASOLINE BLENDS WITH MOTOR VEHICLE FUEL SYSTEMS
Robert J. Garbe May 1981 18 p refs
(PB82-117904; EPA-AA-CTAB/PA/81-12) Avail: NTIS
HC A02/MF A01 CSCL 21D

The compatibility effects of methanol/gasoline blends on vehicle systems were as part of a larger effort by EPA to evaluate the request to a waiver of the Section 211(F) fuel additive regulations submitted by Anafuel Unlimited on February 20, 1981. This waiver was requested by Anafuel for Petrocoal, an oxygenated, unleaded gasoline blend containing up to 12% methanol, up to 6% C-4 alcohols (not identified) and up to 0.033 g/gal but not less than 0.023 g/gal of a proprietary compound claimed by Anafuel to be a corrosion inhibitor. GRA

N82-21691# Curtiss-Wright Corp., Wood-Ridge, N.J. Power Systems Div.
HIGH-TEMPERATURE-TURBINE TECHNOLOGY PROGRAM. PHASE 2: TECHNOLOGY TEST AND SUPPORT STUDIES. REFERENCE TURBINE SUBSYSTEM DESIGN: PHASE 2 REPORT
Jun. 1981 92 p refs
(Contract DE-AC01-76ET-10348)
(DE81-030059; CW-WR-76-020.74A; FE-2291-74A) Avail: NTIS HC A05/MF A01

The design and operation of a gas turbine and combustor for a combined cycle power plant to be run on coal derived fuels and with turbine inlet temperatures of 2600 to 3000 F are described. The turbine subsystem design, i.e., blades, vanes, shaft, bearings, etc. are emphasized. Materials selection information and heat transfer analyses are included. DOE

N82-21693# Equity Oil Co., Salt Lake City, Utah.
BX IN-SITU OIL-SHALE PROJECT Quarterly Technical Progress Report, 1 Jun. - 31 Aug. 1981
Paul M. Dougan 20 Sep. 1981 144 p refs
(Contract DE-FC20-78LC-10747)
(DE82-002134; DOE/LC-10747/T4) Avail: NTIS HC A07/MF A01

The superheated steam injection at the BX In Situ Oil Shale Project is reported. Injection was continuous except for a period when the injection was suspended during the drilling of core hole BX-37. During the quarter, 99,760 barrels of water as superheated steam were injected into project injection wells at an average well head temperature of 7520 F and an average wellhead pressure of 1312 PSIG. During the same period, 135,469 barrels of fluid were produced from the Project production wells for a produced to injected fluid ratio of 1.36 to 1.0. Net oil production during the quarter was 38 barrels. DOE

N82-21694# New Mexico Inst. of Mining and Technology, Socorro. Petroleum Recovery Research Center.
MEASUREMENT AND CORRELATION OF CONDITIONS FOR ENTRAPMENT AND MOBILIZATION OF RESIDUAL OIL Final Report
N. R. Morrow Sep. 1981 115 p refs
(Contract DE-AS01-78ET-12077)
(DE82-001940; EMD-2-68-3302) Avail: NTIS HC A06/MF A01

Six major tasks are discussed capillary number relationships for rock samples; residual oil saturations near the wellbore; residual oil structure; effect of gravity on residual saturation; magnitude of residual oil saturation; and effects of wettabilityon on capillary number relationships. Detailed progress reports are presented for each task. Measurements of relationships between the ratio of viscous to capillary forces and the reduction in normal waterflood residual oil for a variety of rock types indicate the relative ease with which residual oil can be immiscibly displaced by a tertiary process. In reducing the amount of trapped oil to 50% of normal residual oil saturation, recovery of continuous oil is significantly easier than mobilization of trapped oil. The relative permeabilities of the water phase at reduced residual oil saturations are found to be independent of the displacement mechanism of oil movement by which the reduced residual saturations were achieved. T.M.

N82-21761# Arizona Solar Energy Commission, Phoenix.
EVALUATION OF GEOTHERMAL ENERGY IN ARIZONA Quarterly Topical Progress Report, 1 Apr. - 30 Jun. 1981
D. H. White 1981 43 p Prepared in cooperation with Arizona State Univ., Tempe and Arizona Univ., Tucson
(Contract DE-FC03-80RA-50076)
(DE82-000127; DOE/RA-50076/T5) Avail: NTIS HC A03/MF A01

The identification and delineation of geothermal prospects, the comparison of conventional energy use patterns with geothermal sources, the preparation of area development plans and the compilation of detailed economic and energy data for each area are discussed. Current emphasis is on commercialization. DOE

N82-21773# Office of Technology Assessment, Washington, D. C.
TECHNOLOGY AND SOVIET ENERGY AVAILABILITY
Nov. 1981 415 p
(PB82-133455; LC-81-600166) Avail: NTIS HC A18/MF A01 CSCL 10A

This study addresses in detail the significance of American petroleum equipment and technology to the U.S.S.R. and the resulting options for U.S. policy. It examines the problems and opportunities that confront the U.S.S.R. in its five primary energy industries: oil, gas, coal, nuclear, and electric power. It discusses plausible prospects for these industries in the next ten years; identifies the equipment and technology most important to the U.S.S.R. In these areas; evaluates the extent to which the United States is the sole or preferred supplier of such items and analyzes the implications for both the entire Soviet bloc and the Western alliance of either providing or withholding Western equipment and technology. GRA

N82-21780# General Electric Co., Schenectady, N. Y. Energy Systems Programs Dept.
ELECTROCYCLONE DEVELOPMENT PROGRAM Quarterly Technical Report, May - Jul. 1981
1981 26 p
(Contract DE-AC21-80ET-17091)
(DE81-030004; DOE/ET-17091/T3; FE-7091-14) Avail: NTIS HC A03/MF A01

An electrostatically augmented cyclone high efficiency, high throughout gas cleanup device for pressurized fluidized bed application is discussed. The use of large electrocyclones, with individual lockhopters and inlet/outlet ducts, will avoid the plugging and flow imbalance problems. The electrocyclone development program addresses three critical development areas: (1) performance scaleup; (2) performance at high temperature and pressure; and (3) corona charging. The performance at high temperature and pressure will be demonstrated by actual PFB tests on an 18 in. model geometrically identical to the earlier cold flow model. Preferred electrode geometries and the effects of alkali metal salt vapor on corona current under controlled conditions are determined. The electrocyclone PFB test will confirm the design approach and corona charger performance. DOE

N82-21810# Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
FAULT AND JOINT GEOMETRY AT RAFT RIVER GEOTHERMAL AREA, IDAHO
L. R. Guth, R. L. Bruhn, and S. L. Beck Jul. 1981 23 p refs
(Contract DE-AC07-79ID-12079)
(DE82-003942; DOE/ID-12079-41) Avail: NTIS HC A02/MF A01

Raft River geothermal reservoir is formed by fractures in sedimentary strata of the Miocene and Pliocene salt lake formation. The fracturing is most intense at the base of the salt lake formation, along a decollement that dips eastward at less than 50 on top of metamorphosed precambrian and lower paleozoic rocks. Core taken from less than 200 m above the decollement contains two sets of normal faults. The major set of faults dips between 500 and 700. These faults occur as conjugate pairs that are bisected by vertical extension fractures. The second set of faults dips 100 to 200 and may parallel part of the basal decollement or reflect the presence of listric normal faults in the upper plate. Surface joints form two suborthogonal sets that dip vertically. East-northeast-striking joints are most frequent on the limbs of the Jim Sage anticline, a large fold that is associated with the geothermal field. DOE

N82-21847# National Maritime Inst., Teddington (England). Wind Engineering Services.
REQUIREMENTS FOR THE PROVISION OF OFFSHORE WIND DATA RELATING TO WIND ENERGY CONVERSION SYSTEMS
R. I. Harris Feb. 1980 30 p refs

(NMI-R-75) Avail: NTIS HC A03/MF A01

The requirements for environmental data relating to offshore wind energy conversion systems in the United Kingdom to provide a basis for analysis of wind climate and wind structure in offshore wind energy systems are discussed. A review of available data, a measurement program to study offshore wind structure, and an analysis of the sensitivity of the system to wind parameters are proposed. A detailed measurement program at potential sites, a study of the changes and rates of change of wind structure from land to sea, and a feasibility study of an alternative and potentially cheap operational wind energy prediction method are also included. Author (ESA)

05
ENERGY CONVERSION

Includes photovoltaic, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors and magnetohydrodynamic generators.

A82-18840 † Forms of energy and their transformation (Vidy energii i ikh transformatsii). L. I. Sedov. *(Vsesoiuznyi S'ezd po Teoreticheskoi i Prikladnoi Mekhanike, Alma-Ata, Kazakh SSR, May 27, 1981.) Prikladnaia Matematika i Mekhanika*, vol. 45, Nov.-Dec. 1981, p. 963-984. 32 refs. In Russian.

An examination is presented of initial basic relationships (e.g., force laws and scalar energy laws) for pure mechanical phenomena or for small individualized volumes of matter and fields in physical processes of a general form with internal and external interactions accompanied by transformations of different forms of energy. Attention is given to the meaning of various model representations, particularly space-time models, concepts of general reference systems, global or local tetrad coordinate systems, and universal and particular physical characteristic concepts possessing the properties of covariance. The general theory of admissible postulates, for use in initial thermodynamic principles, is developed. B.J.

A82-18900 International Conference on Thermoelectric Energy Conversion, 3rd, University of Texas, Arlington, TX, March 12-14, 1980, Proceedings. Conference sponsored by the Institute of Electrical and Electronics Engineers and University of Texas. Edited by K. R. Rao. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 225 p. Members, $22.50; nonmembers, $30.

Papers were presented on thermoelectric generators and materials, including the use of selenides, SiGe alloys, and performance prediction. Further attention was devoted to other thermoelectric devices and novel applications, with mention made of thermal and finite element analysis, high efficiency conversion, element fabrication, thermoelectric condensors for adsorption refrigeration and spacecraft heat rejection using thermoelectric materials. Thermoelectric heat pumps were examined, with consideration given to figures-of-merit for BiSb alloys, designs for maximum cool-down speed, and solid state cooling of spaceborne IR focal planes. Finally, international programs were reviewed, and involved the preparation of thermoelectric thin films, the optimization of an isotopic microgenerator design, and the optimization of eutectic thermoelectric elements. M.S.K.

A82-19052 # Simulation and operations of large wind machines. O. Wasynczuk (Purdue University, West Lafayette, IN). In: Annual Allerton Conference on Communication, Control, and Computing, 18th, Monticello, IL, October 8-10, 1980, Proceedings. Urbana, IL, University of Illinois, 1980, p. 187-195. 10 refs. Contract No. DE-AS02-77ET-29100.

The operating characteristics of a class of large, multi-megawatt wind turbine generators is examined. Design features relevant to the dynamic and transient behavior of this particular class of wind turbine generators are described. Results from hybrid computer simulation studies are included to illustrate the dynamic behavior of this class of wind turbine generators operating in a turbulent wind environment and also the transient behavior following electrical disturbances. (Author)

A82-19054 # Integration problems with large wind energy conversion systems. R. J. Thomas and J. S. Thorp (Cornell University, Ithaca, NY). In: Annual Allerton Conference on Communication, Control, and Computing, 18th, Monticello, IL, October 8-10, 1980, Proceedings. Urbana, IL, University of Illinois, 1980, p. 206-213.

This paper is concerned with the problems associated with integrating clusters of large wind-turbine generators into a utility grid system. The use of a series-connected AC/DC/AC interface, specifically designed for intermittent sources of energy such as wind-turbine generators, is suggested as a means for circumventing the economic and technical problems associated with present thought in protection and interconnection schemes. Penetration levels as a function of worst-case stability limits, dynamic siting issues, and cluster-control problems are also addressed. (Author)

A82-19103 Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. Workshop sponsored by the British Wind Energy Association. London, Multi-Science Publishing Co., Ltd., 1980. 234 p.

After presenting status reports on the U.S. and British wind energy development programs, consideration is given to a vertical axis variable geometry wind turbine, an extended multiple streamtube theory for vertical axis wind turbines, blade shapes for horizontal axis wind turbines, a comparison of studies of wind energy conversion system economics for utility applications, and wind energy systems with battery storage and diesel back-up for isolated communities. Also covered are the storage of wind energy as a liquid fuel, the offshore siting of wind turbine generators in U.K. waters, the predictability of wind turbine output, wind data requirements for wind turbine generator design, and wake structure analysis. O.C.

A82-19104 The Rutherford six meter variable-geometry vertical axis wind turbine. G. Stacey and P. J. Musgrove (Reading, University, Reading, Berks., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 21-29. 9 refs. Science Research Council Grant No. GR/A/7483/8.

The paper describes the six-meter, vertical axis variable-geometry wind turbine originally destined for the Cambridge Autarkic House Project but now remaining at the Rutherford Laboratory as a research machine. Predicted performance using both single- and multi-streamtube models is shown, complete with an analysis of the losses between rotor and generator output, for both the two-blade and three-blade configurations. Initial field measurements for the two-blade version are reported. Measured performance is compared both with predicted performance curves and with results from similar machines. Finally, a brief description of future work is given. (Author)

A82-19105 Double output induction generator scheme for wind energy conversion. H. R. Bolton, W. C. Lam, and L. L. Freris (Imperial College of Science and Technology, London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 30-40. 15 refs. Research supported by the Science Research Council.

Methods for increasing the operating speed ranges for grid-connected, three phase induction generators in windpowered turbines are presented. The recovery of 'slip energy', which occurs when the wind turbine encounters winds above the rated speed, is shown to be achievable by the use of an external resistor circuit. The excess power normally shunted into the coils of the field is used to produce heat in a water storage tank or water heater, with possible applications in homes, greenhouses, and industry. A numerical model is formulated which takes into account supersynchronous generating operation, the presence of a hot water resistor bank, and the treatment of heat dissipation. Finally, safety considerations during outage and tariff rates for privately-owned windpowered generators feeding into the grid are discussed, noting favorable rates for utility buyback will encourage the use of wind turbines and help replace the burning of fuel. M.S.K.

A82-19106 A review of medium-scale wind turbine generators. B. Buss and W. E. Hardy (ERA Technology, Ltd., Leatherhead, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 41-50.

A82-19107 Performance measurements on the six meter diameter horizontal axis windmill. P. D. Dunn, T. Eisa, A. Ibbetson (Reading, University, Reading, Berks., England), and M. Ewens (Intermediate Technology Development Group, London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 57-64.

A82-19108 **An extended multiple streamtube theory for vertical axis wind turbines.** S. Read and D. J. Sharpe (Kingston Polytechnic, Kingston-on-Thames, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 65-72. 7 refs.

A82-19109 **Calculation of the flow patterns and performance of wind turbines using streamline curvature methods.** D. J. Milborrow and J. F. Ainslie (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 73-83. 16 refs.

Streamline curvature techniques have been used to make predictions of the flow patterns in the vicinity of wind turbines and also of the variations of static pressure within the flowfield. These studies have been carried out 1) to enable measuring techniques to be improved, 2) to obtain a better insight into the behaviour of rotors at high loadings, where the existing performance theories predict reversed flow in the wake of the machine, 3) to obtain more information on the processes involved in the generation of decay of the rotor wakes, for correlation with studies related to the performance of arrays of wind turbines. The flow patterns and performance data generated have been correlated with data from other studies. It is shown that, when used in conjunction with existing aerodynamic prediction methods, streamline curvature techniques improve the accuracy of performance estimates. (Author)

A82-19110 **Blade shapes for horizontal axis wind turbines.** M. B. Anderson (Cambridge University, Cambridge, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 84-95. 6 refs. Research supported by the Science Research Council.

A method is presented for determining the optimum blade shape for a turbine operating at a constant rotational speed. Weibull functions are used to determine a weighting distribution in the optimisation procedure. A comparison is made between near-optimum and optimum blade shapes for turbines operating at both constant tip speed ratio and constant rotational speed. (Author)

A82-19111 **Wind tunnel tests on the 1/30th scale model of the 60m wind turbine generator.** M. Buckley (British Aerospace Public, Ltd., Co., Mechanical Equipment and Systems Div., Hatfield, Herts., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 96-108.

To provide confirmation of aerodynamic data used in the design of the full-scale machine, a one-thirtieth scale model was designed and constructed for a test program in a low speed wind tunnel. Measurements were obtained of rotor forces using strain gauges on the blade roots and drive shaft, as well as overall forces on the wind tunnel balance. The design of the machine, the instrumentation system employed and the data reduction procedures are presented in this paper. (Author)

A82-19113 **A comparison of studies of WECS economics for utility applications.** R. H. Taylor and A. P. Rockingham (Central Electricity Generating Board, Planning Dept., London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 118-126. 14 refs.

Several studies world-wide have now been completed which analyse the economic value of wind energy conversion systems (WECS) when incorporated in utility grids. This paper reviews the models which have been used and compares the main conclusions. Results of general applicability suggest that for most utilities, the largest part of the value results from fuel saving, but that capacity credit may be significant in some cases. It has been found that the value of WECS decreases with penetration and it is now generally agreed that any storage included in the system should not be dedicated to wind power but used for the benefit of the entire system. The reasons for the sometimes large quantitative differences in capacity credit and differences in total value as a function of penetration between studies are not apparent, and it is concluded that studies must be carried out for individual utilities employing appropriate wind characteristics, yearly and daily load curves and mixes of plant. (Author)

A82-19114 **The expected cost of electricity generated by the U.S. Mod 2 windmill.** R. Lowe (Open University, Milton Keynes, Bucks., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 127-133.

A82-19115 **Wind energy systems with battery storage and diesel back-up for isolated communities.** G. Slack, B. Sexon, R. Collins, P. Dunn, N. Lipman, and P. Musgrove (Reading, University, Reading, Berks., England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. (A82-19103 07-44) London, Multi-Science Publishing Co., Ltd., 1980, p. 134-142.

A82-19117 **Wind power integration studies - An overview of the Reading University programme.** N. H. Lipman (Reading, University, Reading, Berks.; Science Research Council, Rutherford and Appleton Laboratories, Didcot, Oxon, England), E. Bossanyi, P. D. Dunn, P. J. Musgrove, G. E. Whittle (Reading, University, Reading, Berks., England), and C. Maclean (Science Research Council, Rutherford and Appleton Laboratories, Didcot, Oxon, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 151-162.

Preliminary results of studies of the operational characteristics and performance of windpowered turbine clusters are reported. The chance that short gusts above the cut-off speed may cause shutdowns lasting 10-20 min is considered as a control system problem, and it is found that steadier output can be expected from clusters rather than single machines. Wake effects are mentioned, and ongoing studies of simultaneous winds at nine separate sites are indicated. The prediction of wind energy shortfalls is discussed, noting that steadier power can be expected from diverse clusters rather than single site clusters. The interface of spinning reserve to make up the shortfalls when the wind dies down is modeled, and it is shown that wind turbines are capable of producing 30% of the annual electrical demand. The fuel cost for spinning reserve is calculated to be less than having a peaking plant. M.S.K.

A82-19121 **The predictability of wind turbine output.** E. A. Bossanyi, G. E. Whittle, P. D. Dunn, N. H. Lipman, P. J. Musgrove (Reading, University, Reading, Berks., England), and C. Maclean (Science Research Council, Rutherford and Appleton Laboratories, Didcot, Oxon, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 194-201. 5 refs.

A method of bins was used with hourly mean wind speeds to predict the output of wind turbines. Rated capacity was regarded as unity and power surpluses or deficits were calculated over 40 bins to establish error probabilities in the predictions of wind speed persistence six hours in advance. Higher rated wind speeds were found to increase the probability for correct predictions of output, while factors such as variable pitch and speed also contributed an influence. The persistence method was favorably compared with 6, 12, and 18 hr wind forecasts by a meteorological office. A final test was made employing 6 hr predictions for three widely spaced sites on the same coast, and the error probability was found to decrease with increasing numbers of sites. Further predictive tests with more than three sites at even greater spacing are indicated. M.S.K.

A82-19122 **Wind data requirements for wind turbine generator design.** U. Hassan (ERA Technology, Ltd., Leatherhead, Surrey, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 202-210. 9 refs.

The statistical methods of wind modeling for the design of tall masts, buildings, towers, and bridges are shown to be effective for the analysis of wind loads on wind turbine generators (WTG). The wind velocity profile and turbulence is defined as the instantaneous deviations from the short term mean wind speed, and is capable of reducing the fatigue life of the rotors and degrading the quality of power output. The simplified definition of turbulence is noted to be

deficient in its ability to predict the effects of sequential gusts on the rotors, or to show the changes in torque encountered by the rotor swept area. A relationship between the force spectrum and the velocity spectrum is analytically defined to obtain a response spectrum. Finally, the differences in wind speeds in the vertical wind profile are quantified. M.S.K.

A82-19123 Wake structure analysis. B. R. Clayton and P. Filby (University College, London, England). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 211-220. 19 refs. Research supported by the Science Research Council.

Two related aerodynamic problems, namely the wake interaction effect and the scale effect, need examination in order to predict the full-scale performances of wind turbines in isolation and in arrays. Wake interaction arises from the desire to minimize the surface area occupied by an array. The aerodynamic conditions for each turbine are therefore influenced by the presence of other turbines in the array. Scale effects result from the practical difficulties of satisfying dynamic similarity between full-scale and model flow conditions. Existing data related to these problems are analyzed, and a program including the construction of an experimental rig is described in order to fill the present gaps in knowledge so that full-scale predictions may become more reliable. (Author)

A82-19124 Initial test results on the 5m horizontal axis wind turbine at Swansea. R. G. Herapath and M. G. Woollard (Swansea, University College, Swansea, Wales). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 223-228.

A82-19241 Real-time simulation of MHD/steam power plants by digital parallel processors. R. M. Johnson and D. A. Rudberg (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 274-277. 6 refs.

Attention is given to a large FORTRAN coded program which simulates the dynamic response of the MHD/steam plant on either a SEL 32/55 or VAX 11/780 computer. The code realizes a detailed first-principle model of the plant. Quite recently, in addition to the VAX 11/780, an AD-10 has been installed for usage as a real-time simulation facility. The parallel processor AD-10 is capable of simulating the MHD/steam plant at several times real-time rates. This is desirable in order to develop rapidly a large data base of varied plant operating conditions. The combined-cycle MHD/steam plant model is discussed, taking into account a number of disadvantages. The disadvantages can be overcome with the aid of an array processor used as an adjunct to the unit processor. The conversion of some computations for real-time simulation is considered. G.R.

A82-19242 Digital simulation of an MHD power consolidation/D.C. to A.C. inverter system. K. Crisafulli, R. Johnson, and K. Marcotte (Montana State University, Bozeman, MT). In: Summer Computer Simulation Conference, Washington, DC, July 15-17, 1981, Proceedings. Arlington, VA, AFIPS Press, 1981, p. 308-311.

A82-19297 Performance characteristics of open-cycle linearly-diverging diagonal type single- and multiple-load generators. M. Yoshida and J. Umoto (Kyoto University, Kyoto, Japan). *Energy Conversion and Management*, vol. 21, no. 4, 1981, p. 289-297. 12 refs.

A quasi-two-dimensional theory for evaluating the performance of a diagonal type MHD generator is presented. An equivalent circuit theory is used to describe the distributions of electric quantities in the channel, and the distribution of gas-dynamical quantities in the core flow region are obtained by means of modified one-dimensional MHD flow equations. The electrical quantities in that region are expressed as averages of the previously derived two-dimensional electrical quantities perpendicular to the gas flow, while the electrical quantities in the boundary layer flow are calculated by using the momentum integral equation and the 1/7 power profiles for the gas temperature and velocity under the assumption of turbulent flow. The theory is applied to a diagonal type generator with a thermal output of 2 GW and the results are compared to those from quasi-one-dimensional calculations. M.S.K.

A82-19794 # Three-dimensional flow development in MHD generators at part load. E. D. Doss and R. K. Ahluwalia (Argonne National Laboratory, Argonne, IL). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0324*. 13 p. 9 refs. Contract No. W-31-109-eng-38.

The three-dimensional behavior of flow in MHD generators at design and off-design loading points is investigated. Faraday as well as diagonally-connected channels with insulating or conducting sidewalls are considered. A simple argument is presented to show qualitatively the role of MHD body forces in generating axial vorticity and hence secondary flows in the cross stream. For Faraday channels with strong MHD interaction, the generated vorticity is shown to direct the secondary flow from the cathode to the anode wall along the centerline. For diagonally-connected channels near short-circuit, the generated vorticity is shown to direct the secondary flow from the anode to the cathode wall along the centerline, and vice-versa for near open-circuit conditions. Computational results for large generators are presented and the effect of channel loading on the flow characteristics are discussed. (Author)

A82-19795 # Preliminary investigation of the effect of electrical nonuniformities on frame current distribution of coal-fired MHD generator. M. Ishikawa, Y. C. L. Wu, and M. H. Scott (Tennessee, University, Tullahoma, TN). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0326*. 11 p. 11 refs. Contract No. DE-AC02-79ET-10815.

The effect of electrical nonuniformities on frame currents in a diagonal conducting wall generator is examined by comparing three-dimensional calculations with experimental data. It is found that variations of frame current are much stronger at the cathode side than at the anode side; large local changes may occur in the frame currents that have little correlation with the overall performance. Frame currents flowing counter to the normal flow were predicted by the three-dimensional calculations and observed experimentally. This behavior is attributed to leakage through polarized slags. For three-electrode frame configurations, calculations show current conservation and predict the tendency as well as the magnitude of frame currents observed experimentally. V.L.

A82-19800 # Recent results on measurement of plasma conductivity using Faraday rotation of submillimeter waves. P. J. Kuzmenko and S. A. Self (Stanford University, Stanford, CA). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0376*. 8 p. 12 refs. NSF-supported research.

This paper examines the application of Faraday rotation to the measurement of electron concentration in combustion MHD plasmas. Details on the design of a working system are given including the selection of operating wavelength. A theoretical comparison between the Faraday rotation technique and two path interferometry shows Faraday rotation in its simplest form to be somewhat less sensitive to changes in electron concentration. This deficit can be balanced against greater immunity to vibration and thermal drift. Improved techniques of measuring the rotation angle promise greater sensitivity. A preliminary experiment has verified the technique. (Author)

A82-20140 Possibilities and limitations of wind energy utilisation. J. Feustel (M.A.N. - Neve Technologie, Munich, West Germany). *International Journal of Ambient Energy*, vol. 2, Oct. 1981, p. 197-205. 10 refs.

The existing wind resource, the most favorable locations, applications, and designs of windpowered generators are reviewed, along with descriptions of current and historic wind turbines and lines of research. Coastal regions, plains, hill summits, and mountains with funneling regions are noted to have the highest annual wind averages, with energy densities exceeding the annual solar insolation at average wind speeds of 5-7.9 m/sec. Applications for utility-grade power production, for irrigation, for mechanical heat production,

and for pumped storage in water towers or reservoirs are mentioned, as well as electrical power production in remote areas and for hydrogen production by electrolysis. Power coefficients are discussed, with attention given to the German Growian 3 MW machine. It is shown that the least economically sound wind turbines, the machines with outputs below 100 kW, can vie with diesel plant economics in a good wind regime if the wind turbine operates for 15 yr. M.S.K.

A82-20170 Fusion - From science to engineering. J. Kenton. *EPRI Journal*, vol. 6, Dec. 1981, p. 63, 64, 66-68, 70. 8 refs.

The principles and state of advancement in fusion energy devices are explored, along with the transition from theoretical problems to engineering difficulties. Tokamaks are noted to be the closest to actual break-even, the point where the energy extracted from the reactor is equal to the energy necessary to initiate the process, although linear, mirror fusion machines also show promise. Attention is also given to poloidal diverter systems and the ELMO bumpy torus, which has demonstrated continuous operation for the first time. The prospects for a U.S. fusion engineering facility are uncertain in the light of current budget cuts, with most funding being concentrated on military applications. Laser inertial fusion devices are reviewed, as well as particle and ion accelerators for fuel pellet implosions. Finally, the most complex engineering problem is asserted to be the development of the reactor blanket system. M.S.K.

A82-20175 Power systems. G. Kaplan. *IEEE Spectrum*, vol. 19, Jan. 1982, p. 65-68.

Significant events in current, prototype, and experimental utility power generating systems in 1981 are reviewed. The acceleration of licensing and the renewal of plans for reprocessing of fuel for nuclear power plants are discussed, including the rise of French reactor-produced electricity to over 40% of the country's electrical output. A 4.5 MW fuel cell neared completion in New York City, while three 2.5 MW NASA-designed windpowered generators began producing power in the state of Washington. Static bar compensators, nonflammable-liquid cooled power transformers, and ZnO surge arrestors were used by utilities for the first time, and the integration of a coal gasifier-combined cycle power plant approached the planning phase. An MHD generator was run for 1000 hours and produced 50-60 kWe, while a 20 MVA superconducting generator was readied for testing. M.S.K.

A82-20283 The rebirth of MHD. M. Edelhart and A. Greenfield. *Technology*, vol. 2, Jan.-Feb. 1982, p. 79-83.

A low-temperature MHD system employing liquid metal and a low-boiling point organic vapor as its working fluids is described, and considered from the standpoints of: (1) development status; (2) thermal energy sources, with emphasis on low-temperature solar collectors and industrial process waste heat; (3) economic advantage, by comparison to Rankine-cycle and photovoltaic solar systems; and (4) operational efficiency. Figures for the net cost of power produced by the three solar systems compared, when the further conversion of MHD exhaust heat is considered, are $0.57/kWh for the photovoltaic, $0.116/kWh for the Rankine cycle, and $0.054/kWh for the low-temperature MHD. A further contrast is drawn with the typically 2500 C-working gas MHD systems being developed in the U.S. and U.S.S.R. O.C.

A82-20292 * # Effect of vacuum exhaust pressure on the performance of MHD ducts at high B-field. J. M. Smith, J. L. Morgan, and S.-Y. Wang (NASA. Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 20th, Orlando, FL, Jan. 11-14, 1982, Paper 82-0396*. 10 p.

The effect of area ratio variation on the performance of a supersonic Hall MHD duct showed that for a given combustion pressure there exists an area ratio below which the power generating region of the duct is shock free and the power output increases linearly with the square of the magnetic field. For area ratios greater than this, a shock forms in the power generating region which moves upstream with increasing magnetic field strength resulting in a less rapid raise in the power output. The shock can be moved downstream by either increasing the combustion pressure or decreasing the exhaust pressure. The influence of these effects upon duct performance is presented in this paper. (Author)

A82-20739 * # High temperature durable catalyst development. G. C. Snow and H. Tong (Acurex Corp., Mountain View, CA). *Workshop on Catalytic Combustion, 5th, San Antonio, TX, Sept. 15, 16, 1981, Paper.* 38 p. 14 refs. Research supported by the Acurex Corp.; U.S. Environmental Protection Agency Contract No. 68-02-3122; Contract No. DEN3-83.

A program has been carried out to develop a catalytic reactor capable of operation in environments representative of those anticipated for advanced automotive gas turbine engines. A reactor consisting of a graded cell honeycomb support with a combination of noble metal and metal oxide catalyst coatings was built and successfully operated for 1000 hr. At an air preheat temperature of 740 K and a propane/air ratio of 0.028 by mass, the adiabatic flame temperature was held at about 1700 K. The graded cell monolithic reaction measured 5 cm in diameter by 10.2 cm in length and was operated at a reference velocity of 14.0 m/s at 1 atm. Measured NOx levels remained below 5 ppm, while unburned hydrocarbon concentrations registered near zero and carbon monoxide levels were nominally below 20 ppm. V.L.

A82-20743 * # Power system design optimization using Lagrange multiplier techniques. Y. Yu (Xerox Corp., El Segundo, CA) and F. C. Lee (Virginia Polytechnic Institute and State University, Blacksburg, VA). *Power Conversion International Conference, Munich, West Germany, Sept. 14, 1981, Paper.* 18 p. 8 refs. Contract No. NAS3-21051.

An optimization technique using the Lagrange Multiplier Method is proposed to facilitate design of switching power converter systems. The essence of the optimization is to identify the optimal battery voltage level and switching frequency along with the detailed converter design so that the total system weight including the battery and the packaged converter is minimized, and concurrently all specified power circuit performances are satisfied. (Author)

A82-20744 * A PWM transistor inverter for an ac electric vehicle drive. J. M. Slicker (Eaton Engineering and Research Center, Southfield, MI). *Institute of Electrical and Electronics Engineers, Annual Meeting, Philadelphia, PA, O[illegible] 5-9, 1981, Paper.* 8 p. 8 refs. Research supported by the U.S. Department of Energy; Contract No. DEN3-125.

A prototype system consisting of closely integrated motor, inverter, and transaxle has been built in order to demonstrate the feasibility of a three-phase ac transistorized inverter for electric vehicle applications. The microprocessor-controlled inverter employs monolithic power transistors to drive an oil-cooled, three-phase induction traction motor at a peak output power of 30 kW from a 144 V battery pack. Transistor safe switching requirements are discussed, and a circuit is presented for recovering trapped snubber inductor energy at transistor turn-off. V.L.

A82-20747 * # Comparative analysis of CCMHD power plants. F. N. Alyea, C. H. Marston, V. B. Mantri (General Electric Co., Energy Systems Programs Dept., Philadelphia, PA), B. G. Geisendorfer (Babcock and Wilcox Co., Fossil Power Generation Div., Barberton, OH), and H. Doss (Bechtel National, Inc., San Francisco, CA). *Symposium on the Engineering Aspects of MHD, 19th, Tullahoma, TN, June 15-17, 1981, Paper.* 8 p. Contract No. DEN3-135; No. DE-AC01-78ET-10818.

A study of Closed Cycle MHD (CCMHD) power generation systems has been conducted which emphasizes both advances in component conceptual design and overall system performance. New design data are presented for the high temperature, regenerative argon heaters (HTRH) and the heat recovery/seed recovery (HRSR) subsystem. Contamination of the argon by flue gas adsorbed in the HTRH is examined and a model for estimation of contamination effects in operating systems is developed. System performance and cost data have been developed for the standard CCMHD/steam cycle as powered by both direct fired cyclone combustors and selected coal gasifiers. In addition, a new CCMHD thermodynamic cycle has been identified. (Author)

A82-20750 * # MHD channel performance for potential early commercial MHD power plants. D. W. Swallom (Avco-Everett Research Laboratory, Inc., Everett, MA). *Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, Aug. 9-14, 1981,*

Paper, 7 p. 15 refs. Contract No. DEN3-51.

The commercial viability of full and part load early commercial MHD power plants is examined. The load conditions comprise a mass flow of 472 kg/sec in the channel, Rosebud coal, 34% by volume oxygen in the oxidizer preheated to 922 K, and a one percent by mass seeding with K. The full load condition is discussed in terms of a combined cycle plant with optimized electrical output by the MHD channel. Various electrical load parameters, pressure ratios, and magnetic field profiles are considered for a baseload MHD generator, with a finding that a decelerating flow rate yields slightly higher electrical output than a constant flow rate. Nominal and part load conditions are explored, with a reduced gas mass flow rate and an enriched oxygen content. An enthalpy extraction of 24.6% and an isentropic efficiency of 74.2% is predicted for nominal operation of a 526 MWe MHD generator, with higher efficiencies for part load operation. M.S.K.

A82-21148 Interfacing wind energy conversion equipment with utility systems. R. C. Meier and S. L. Macklis (General Electric Co., Advanced Energy Programs Dept., Philadelphia, PA). *Energy* (UK), vol. 7, Jan. 1982, p. 15-29.

Methods and problems of interfacing the output of wind energy conversion systems (WECS) with the utility grid are examined. Local gusts were determined to be the main cause of loss of output stability, with the concomitant possibility of going off-line until resynchronization is effected. The problem is less common than loss-of-load due to low- or no-wind conditions, and synchronous generators were found to avoid unacceptable voltage dips from moderate disturbances. A lumped parameter study was performed for the behavior of a wind turbine cluster, and stability of the WECS output was acceptable as long as the connection reactance between the WECS and the utility was less than 0.4/unit. WECS application in a variety of networks were modeled and no unendurable power fluctuations were seen to threaten the utility lines, provided proper control mechanisms were interposed on-line with the systems using mostly already existing utility circuit protection technology. M.S.K.

A82-21650 Heating by wind (Heizen mit Wind). F. Auer (Battelle-Institut, Frankfurt am Main, West Germany). *Brennstoff-Wärme-Kraft*, vol. 34, Jan. 1982, p. 39-42. In German.

The economical design of a wind power plant combined with a heat accumulator is discussed. A gliding-museum to be built on the Wasserkuppe in the Rhön mountain is used as an example to investigate which wind power plant and storage alternative can be considered based on meteorological basic data and the heat demand required. A system optimization regarding technical and economical points is used to study the wind power plant and to indicate the best accumulator. The maximum storage time established by an economic optimization is one to two days. In this regard no difference is made between sun energy and wind energy, and the storage size can span the day/night cycle. D.L.G.

A82-22896 # Lineup of the IM-series aircraft-derivative gas turbines. K. Takeo (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). *IHI Engineering Review*, vol. 14, Oct. 1981, p. 36-42. 5 refs.

The development of the IM-series of aircraft derivative gas turbines is reviewed. The discussion begins with the IM1500 GL engine, having an output at turbine coupling of 11,100 kW and a thermal efficiency of 26.8%, first used as an industrial gas generator in 1968. Principal characteristics of the IM2000 and IM2500 are then discussed: the output and thermal efficiency of these two models are given as 12,800 kW and 33.5% and 19,300 kW and 35.1%, respectively. Fundamental specifications of the power turbines are described, and the flowpath design is presented. The construction and mechanical design of the engins are described, and results of creep-rupture, high temperature fatigue, and vibratory stress tests are given. Finally, the IM5000 power turbine, with an output of 38,000 kW and an efficiency of 38.4% is described. It is also shown how heat in the high-temperature exhaust gases from the turbines can be used in waste heat recovery systems to improve the total plant efficiency. J.F.

A82-23063 A review of the impact of the environment on aerogenerator materials. A. R. Mortimer (Science Research Council, Rutherford and Appleton Laboratories, Didcot, Oxon, England). *Wind Engineering*, vol. 5, no. 4, 1981, p. 207-218. 37 refs.

Factors which contribute to the unreliability of windpowered generators are examined, with specific regard to the availability of materials, durability, cost, ease of production, and ease of repair. The effects of wind loading and methods for testing salt air contaminants are discussed, along with the effect of moisture, of salt air on lubricants, of microbiological attack, of UV radiation, rain erosion, and icing. The probability of bird strikes is statistically defined, and consideration is given to electrostatic charging, lightning strikes, temperature changes, the corrosion of rubber by ozone, the effects of guano, and wet dry pollution. The visual, EM, and acoustic effects of wind turbines are explored, and production processes which may affect the integrity of the structure are outlined. Finally, failure mechanisms due to salt-air environments are detailed. M.S.K.

A82-23210 An approximate theory of a rapidly rotating windmill. O. Hellman (Turku, University, Turku, Finland). *Journal de Mécanique Appliquée*, vol. 5, no. 4, 1981, p. 429-451. 13 refs.

An approximate theory is presented for the calculation of an optimal windmill rotor based on propeller theory taking into account the effects of blade drag. An expression for the power coefficient of a wind machine is derived from considerations of the relation between the velocity field behind an ideal windmill and the energy produced by it, and the optimal velocity field behind a windmill rotor is analyzed. The problem of configuring windmill rotor blades to reproduce as closely as possible the optimal velocity distribution is then considered in terms of the Prandtl approximation of circulation around the rotor blades, and a procedure for rotor calculation is presented. The calculation of windmill rotor blade optimal parameters is illustrated for the case of the Göttingen 625 wing section. A.L.W.

A82-23652 # The economics of utilizing wind power in apple cold-storage systems. J. M. A. Tanchoco, R. A. Wysk, and W. E. Norris (Virginia Polytechnic Institute and State University, Blacksburg, VA). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 104, Feb. 1982, p. 23-27. 7 refs. Research supported by the U.S. Department of Agriculture.

A computer model for the economics of a wind turbine powered apple cold storage facility is described, based on the performance of a pilot installation. The facility consisted of an 8 kW windmill, storage batteries, a rectifier to convert the windmill ac power to dc for storage, a dc vapor compression refrigeration system, a 1000 bu apple storage building, and an ice-tank thermal storage system. The performance of the pilot plant was monitored for 2 yr, and the model was devised to include the variations of power and wind, the demand for power, and the quantity of auxiliary power required. Important features of an after-tax analysis of the wind turbine economics are outlined, with attention given to the annual cost equivalence for systems with and without a windmill and with consideration for tax write-offs. It was found that the windpowered system was not economical for a 1000 bu facility, but may be applicable in commercial sized operations. M.S.K.

A82-23653 # OTEC gas desorption studies. F. C. Chen and A. Golshani (Oak Ridge National Laboratory, Oak Ridge, TN). *ASME, Transactions, Journal of Solar Energy Engineering*, vol. 104, Feb. 1982, p. 35-40. 10 refs. Contract No. W-7405-eng-26.

Experiments on deaeration in packed columns and barometric intake systems, and with hydraulic air compression for open-cycle OTEC systems are reported. A gas desorption test loop consisting of water storage tanks, a vacuum system, a liquid recirculating system, an air supply, a column test section, and two barometric leg test sections was used to perform the tests. The aerated water was directed through columns filled with either ceramic Raschig rings or plastic pall rings, and the system vacuum pressure, which drives the deaeration process, was found to be dependent on water velocity and intake pipe height. The addition of a barometric intake pipe increased the deaeration effect 10%, and further tests were run with lengths of PVC pipe as potential means for noncondensible disposal through hydraulic air compression. Using the kinetic energy from the effluent flow to condense steam in the noncondensible stream improved the system efficiency. M.S.K.

A82-23680 Sudden loss of rotor blade from wind power

turbine - Calculation of maximax response spectra. B. Akesson and S. Sandstrom (Chalmers Tekniska Hogskola, Goteborg, Sweden). *Journal of Sound and Vibration*, vol. 80, Jan. 8, 1982, p. 81-96. 7 refs.

The maximum response of a linear one-degree-of-freedom system to a transient phase-shifted truncated sinusoidal load is studied. The system represents the nacelle, tower and foundation of a horizontal axis wind power turbine. The load is the horizontal component of the unbalanced centrifugal force from the remaining blade of the turbine rotor when one blade has suddenly broken off (close to the hub). The most dangerous angle of the running rotor at the instant of blade loss is found with respect to different combinations of viscous damping and load duration. Maximax response spectra (envelope spectra) are plotted. A detailed numerical example is given. (Author)

A82-23824 The application of dynamic cold neutron fluoroscopy for the visualisation of fuel and oil system operating characteristics in gas turbine development. P. A. E. Stewart (Rolls-Royce, Ltd., Advanced Projects Dept., Bristol, England). *Aeronautical Journal*, vol. 86, Jan. 1982, p. 23-28. 10 refs.

A82-24015 # Analysis of power takeoff in diagonal conducting wall channels. S. Kuo and E. Levi (New York, Polytechnic Institute, Farmingdale, NY). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 96-103. 7 refs. Contract No. ET-78-C-01-3084.

An analysis of diagonal-conducting-wall MHD channels leads to design principles for the power takeoff and good quantitative agreement with experimental data. The effect of power takeoff schemes on the output power level is investigated analytically. It is found that it is possible to design the electrical circuit of the channel with passive elements in the takeoff region, and, achieve a fairly even load current distribution under changing load conditions without loss of power output. (Author)

A82-24016 # Performance assessment and cost effectiveness of wind energy conversion systems. G. Miller, M. Hoffert, and D. Corren (New York University, New York, NY). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 104-108. 7 refs. Research supported by the Solar Energy Research Institute and New York State Energy Research and Development Administration.

Performance and cost characteristics of wind energy conversion systems (WECS) are assessed. Both technological and cost-effectiveness considerations are discussed for these systems with emphasis on developing appropriate economic measures for the application of electric power generation. A cost-effectiveness analysis is developed for target costs per unit frontal area for such systems showing the influence of annual mean windspeed, tower height, atmospheric boundary layer stability, capital-cost financing rates, and the cost escalation rate of the fossil fuel displaced. The latter two parameters are particularly sensitive ones in assessing both lifetime cost-effectiveness and payback time. Although allowable costs vary be several orders of magnitude, initial target costs for cost-effectiveness seem to be of the order of $50 to $400/sq m of frontal area. (Author)

A82-24018 # Arc mode molten seed electrodes for MHD power generation. S. Korenaga, H. Imai, and T. Masuda (Ministry of International Trade and Industry, Electrotechnical Laboratory, Ibaraki, Japan). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 119-124. 19 refs.

Experiments have been conducted in an electric furnace at atmospheric pressure with the object of investigating the seed arcing characteristics and electrical conductivities of seed materials, and ceramic consumption rates by seed arcing. Many important facts have been clarified from these experiments, namely that the arcing behaviors of molten seeds resemble closely those of mercury in a mercury rectifier, the cathode voltage drop of K2CO3 seed is close to that obtained for the copper electrode in an MHD channel, the molten seed has an electrical conductivity comparable to those of advanced ceramic electrodes, and so on. These results show that so-called 'arc mode molten seed electrodes' are highly promising for practical application. The arc mode molten seed cathodes for commercial MHD generating channels are discussed. (Author)

A82-24020 # Optimization of fuel composition in open-cycle magnetohydrodynamic power generation. C. F. Harris (Dayton, University, Dayton, OH) and A. S. Myerson (Georgia Institute of Technology, Atlanta, GA). *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 155-157. 8 refs. Contract No. F33615-77-C-2004. AF Task 19.

To design an MHD generator in such a way as to reduce its size and weight, the fuel composition corresponding to the maximum power density must be determined. A technique making this determination possible is described. It involves a calculation of the power density resulting from the combustion of a given inlet fuel composition as a function of temperature and pressure for several electrode configurations at a magnetic field strength of 2-6 T. The chemical composition of the combustion products at the specified temperature and pressure are calculated with a computer program. These composition data are then used in calculating the electrical conductivity and Hall parameter at the specified conditions. Gas velocities are calculated at the entrance to the electrode channel employing the energy conservation equation for compressible flow, assuming no friction or heat losses. C.R.

A82-24021 # Theory and performance of a Wells turbine. S. Raghunathan (Belfast, Queen's University, Belfast, Northern Ireland), C. P. Tan, and N. A. J. Wells. *Journal of Energy*, vol. 6, Mar.-Apr. 1982, p. 157-160. 5 refs.

A simple theoretical approach to the design of the Wells turbine is described, with the theoretical prediction then compared with experimental data. In the test, the flow is measured using a calibrated orifice plate mounted at the end of the test section at a distance of 0.7 m from the rotor. The pressure tappings are located at a distance of 0.2 m upstream and downstream of the rotor. Low differential pressure transducers are used. The power output is obtained by measuring both the torque and rotational speed, with the torque being measured by an optical rotary transducer. The turbine is loaded using a dc commutator machine which also serves as a motor to run the turbine up to a required speed. It is observed within the range of experimental data that differences exist between the oscillating flow and steady flow results. It is concluded that the Wells self-rectifying air turbine is a feasible device for converting energy from oscillating wave energy devices. C.R.

A82-24239 Molten carbonate fuel cell improvements. K. F. Blurton and L. G. Marianowski (Institute of Gas Technology, Chicago, IL). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 211-225; Discussion, p. 225, 226. 6 refs. Research supported by the U.S. Department of Energy and Electric Power Research Institute.

It is noted that a molten carbonate fuel cell integrated with a coal gasification power plant is one of the most promising coal-using technologies because of its high efficiency, acceptable cost, and environmental acceptability. For the molten carbonate system to achieve these goals, however, continued development is required which must take into account the operating conditions of the application. The progress made in improving cell performance and life is surveyed, evaluating the effect of contaminants on cell performance and the design of multicell stacks and identifying alternative electrolyte compositions. Also discussed is the status of research on other major areas. C.R.

A82-24249 Al-air cells - Potential small electric generators for field use. T. Valand, O. Mollestad, and G. Nilsson (Forsvarets Forskningsinstitutt, Kjeller, Norway). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 523-533; Discussion, p. 533, 534. 11 refs.

The Al-air system is a very attractive system for use as an electric generator in the field. Besides the high energy density of the 'fuel' (theoretically 21 kW h per l Al), it is easy and safe to handle. Since it reacts in an electrochemical cell, it also easily adjusts to variations in load. In order to test the ability of the system, a 40 W mechanically rechargeable Al-air cell has been constructed. The reaction products, which in a short time will clog up the cell, are continuously removed from the electrolyte. The cell has a total efficiency of approximately 40% and has a current efficiency of

100% with respect to Al. Unfortunately, some serious problems have to be solved before the cell can be put into use. The properties of the cell, the problems, and possible solutions are discussed. (Author)

A82-24382 Evolution and development of high voltage /270 volt/ dc aircraft electric systems in the United States. J. D. Segrest (U.S. Naval Material Command, Naval Air Development Center, Warminster, PA) and W. W. Cloud (Lockheed-California Co., Burbank, CA). In: Aircraft electrical power systems; Proceedings of the Aerospace Congress and Exposition, Anaheim, CA, October 5-8, 1981. Warrendale, PA, Society of Automotive Engineers, Inc., 1981, p. 51-63. 10 refs.

The system concept of high voltage dc power systems for aircraft applications is reviewed, with regard to the state-of-the-art in the hardware available. The history of dc system use is outlined, noting the continually increasing demand of higher voltage levels. Mention is also made of the inherent unsatisfactory lifetime levels of current constant speed 400 Hz power devices with respect to future aircraft. Cycloconverter and DC-Link power generating systems are subject to complex designs and display a poor power factor, wave form distortion, and EM incompatibility. Brushless dc motors are available for engine mounting, and provide 270 V dc, which offers high reliability, high efficiency, light weight, power continuity, fuel economy, and personnel safety. Existing systems and advanced systems are outlined, with operational performance and requirements, including the need to develop solid-state load controllers for over 50 amps power load. M.S.K.

A82-24564 # Frequency response analysis of ocean wave energy converter. M. Masubuchi (Osaka. University, Osaka, Japan) and R. Kawatani. *American Society of Mechanical Engineers, Winter Annual Meeting, Washington, DC, Nov. 15-20, 1981, Paper 81-WA/DSC-10.* 9 p. 13 refs. Members, $2.00; nonmembers, $4.00.

The energy conversion efficiency and dynamic behavior of a wave energy converter which absorbs power while oscillating on an incident sinusoidal wave train are analyzed. The device consists of two, differently-configured floating bodies connected by a rigid link, and its basic equations are obtained by assuming two-dimensional motions and considering the interaction between the two bodies and hydrodynamic and damping forces. Numerical solutions are obtained through the use of the Lewis form as the configuration of the floating bodies. Assuming that energy absorption is proportional to the square of the relative velocity between the oscillating body and the connecting link, it is shown that nearly 100% of incident wave energy is converted into mechanical energy over a wide frequency band. O.C.

A82-24692 Fuel cell power plants for utility applications. L. G. Eklund and L. M. Handley (United Technologies Corp., Hartford, CT). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 143-147. Contracts No. EX-76-C-01-2102; No. EC-77-C-03-1471.

The status of three fuel cell programs as prototypes for commercial fuel cell power plants for utility applications are discussed. The systems use either natural gas or distillate fuels, and are compatible with gaseous or liquid coal products. Two of the systems use phosphoric acid fuel cells as a basic building block in a proof of principle for supplying electricity and other energy requirements for buildings and industrial processes. The plants are on site, and deliver either a few kW to hundreds of kW, or a multimegawatt output for utility applications. A 40 kW unit is described which operates automatically, performs its own heat recovery, recovers water for its own use, and runs a simulated 16-unit apartment building. A 4.8 MW system located in New York city features a power conditioner to alter the dc output to three phase ac for the power grid. Finally, research on utility-size molten carbonate fuel cells offering 40-50% efficiency in converting coal to grid-quality power are described. M.S.K.

A82-24693 Phosphoric acid fuel cell plants for dispersed electric power generation. A. R. Jones (Westinghouse Electric Corp., Advanced Energy Systems Div., Pittsburgh, PA). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 148-153. 8 refs.

The operational characteristics of a phosphoric acid fuel cell are detailed, and features of a commercial prototype fuel cell are described. The fuel cell power plant comprises a fuel processor, fuel cells, and a power conditioner. Hydrogen is extracted from the fuel source, which can be coal, biomass, or wasted natural gas. Reformers are required to reduce CO impurities in the H2 gas fed to the fuel cells. It is projected that fuel cell units are commercially competitive with combustion turbines with current production technology, and can be sited close to the load because of benign environmental effects. The necessity of reliable central control of dispersed fuel cell plants is stressed as means of maintaining efficiency of use. A distributed gas cooling approach to remove rejected heat has been developed for military 1.5 kW fuel cells, and sufficient output to offset parasitic power losses in commercial plants are reviewed. M.S.K.

A82-24694 Engineering development of molten carbonate fuel cell power plants. L. J. Degan (General Electric Co., Schenectady, NY). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 154-159. Research supported by the Electric Power Research Institute and New York State Energy Research and Development Authority.

Initial system goals and modifications in the development of molten carbonate fuel cells are described. The cells are now in the technology readiness stage, with current work applied to fabricating fuel cells and stacks. Initial design goals in 1978 comprised fuel cells suitable for utilities using coal as fuel, and in smaller sizes where waste heat could be utilized for other purposes. Alterations in plans call for a wider choice of fuels, 100-1000 MW sizing for utilities, base load performance, instantaneous change of load, and both ac and dc generation for industrial applications. Sensitivity studies are concentrating on fuel cell pressure levels, excess air ratios, current densities, the anode recirculation ratio, and the steam cycle efficiency, and results of a stimulation of a combined cycle use are reported. Cost sensitivity trials have indicated a necessity to maintain a current density of at least 161.5 mA/sq cm, and sulfur-rich fuels can be used. M.S.K.

A82-24695 * An assessment of alternative fuel cell designs for residential and commercial cogeneration. R. A. Wakefield (Mathtech, Inc., Washington, DC). In: The 1980's - A forest of energy decision trees; Proceedings of the Region Six Conference, San Diego, CA, February 20-22, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 160-165. Research sponsored by the U.S. Department of Energy; Contract No. DEN3-89.

A comparative assessment of three fuel cell systems for application in different buildings and geographic locations is presented. The study was performed at the NASA Lewis Center and comprised the fuel cell design, performance in different conditions, and the economic parameters. Applications in multifamily housing, stores and hospitals were considered, with a load of 10kW-1 MW. Designs were traced through system sizing, simulation/evaluation, and reliability analysis, and a computer simulation based on a fourth-order representation of a generalized system was performed. The cells were all phosphoric acid type cells, and were found to be incompatible with gas/electric systems and more favorable economically than the gas/electric systems in hospital uses. The methodology used provided an optimized energy-use pattern and minimized back-up system turn-on. M.S.K.

A82-24968 High temperature solid electrolyte fuel cell. H. Sato (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan). *(Sun Shine Journal,* vol. 2, no. 1, 1981, p. 26-37.) *Energy Developments in Japan,* vol. 4, Oct. 1981, p. 111-128. Translation.

The components, operating mechanisms, and material for the fabrication of high temperature solid electrolyte fuel cells are described, along with features of a working prototype. The solid electrolyte fuel cell operates at temperatures from 900-1000 C, allowing some impurities in the fuel, and necessitating larger sized units for economic operation. Stabilized zirconia is employed as an

electrolyte with high ionic conductivity, and the movement of oxygen ions in relation to the lattice points is discussed. Porous electrodes composed of zirconia or nickel alloys are chosen as anodes. A tubular shaped structure for the prototype allows three layers of fuel electrode, electrolyte, and an air electrode on the outer surface of a porous substrate tube of Al, and fabrication steps of the cell are provided. An air electrode is used as the cathode, and an output of 12 W is achieved with a flat output characteristic curve, indicating a potential long life. M.S.K.

A82-25160 **New connections for new technologies.** N. Lihach. *EPRI Journal*, vol. 7, Jan.-Feb. 1982, p. 6-11, 13.

Problems and techniques and equipment for utilities to incorporate the electric output from small cogenerators, e.g. wind turbines, solar cells, and fuel cells, into grid quality power are examined. It is noted that currently available power conditioning systems are suitable only for multihundred MW power systems, and have no successful counterparts in the intermediate range. Applications of newly designed power conditioning units in fuel cells and battery installations, using state-of-the-art solid state circuitry, are reviewed. Specific mention is made of harmonics problems, including methods of phase-shaping, wave-shaping, and filtering specific harmonics. Procedures for eliminating electromagnetic impulses at the source are outlined, and the necessity for developing durable power conditioning systems, resistant to a variety of environmental hazards, are stressed, along with the requirements that remote power generation equipment reliably shut down when the utility grid cuts off power to that section due to damage. M.S.K.

A82-25523 **High-efficiency millimetre-wave InP TEOs made by liquid phase epitaxy.** K. H. Yen and J. J. Berenz (TRW Defense and Space Systems Group, Redondo Beach, CA). *Electronics Letters*, vol. 18, Feb. 18, 1982, p. 171, 172.

High-efficiency InP TEO devices have been fabricated by depositing gold-germanium contacts directly on thinned epitaxial layers using DC magnetron sputtering. The best RF performance has been obtained at 34 GHz for devices with an active layer length of 4.4 microns. The highest efficiency measured was 7.6% with 417 mW of power output at 34 GHz; the highest power output was 519 mW with 5.8% efficiency. V.L.

A82-25788 † **Hydraulic models of flow in an MHD generator channel, based on the equations of a two-dimensional boundary layer (O gidravlicheskikh modeliakh techeniia v kanale MGD-generatora, osnovannykh na uravneniiakh ploskogo pogranichnogo sloia).** V. A. Bitiurin, V. A. Zhelnin, G. A. Liubimov, and S. A. Medin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1982, p. 67-75. 10 refs. In Russian.

Flow in an MHD generator channel with a rectangular cross section is examined. It is assumed that the boundary layers on the walls of the channel are sufficiently thin, and that an inviscid core flow is present. It is shown that a hydraulic description of such a flow can be based on the two-dimensional turbulent boundary layer equations, which take into account the transverse inhomogeneities in the flow. Various aspects of the development of such hydraulic models are considered. B.J.

A82-25997 **Wind tunnel tests on slow-running vertical-axis wind-rotors.** S. Sivasegaram (Peradeniya, University, Peradeniya, Sri Lanka). *Indian Academy of Sciences, Proceedings (Engineering Sciences)*, vol. 4, Sept. 1981, p. 395-404. 17 refs.

This paper summarizes the results of investigations on the Savonius-type, slow-running, vertical-axis wind-rotors as well as on rotor designs on different subclasses under comparable design and test conditions. It is seen that the performance of the conventional Savonius rotor could be considerably improved upon and the best results are achieved by using two-bladed rotors with a more sophisticated sectional profile than in the conventional design. Rotors with several blades, although capable of considerably higher performance than the Savonius rotor, do not appear to be as good as those with two blades and improved sectional geometry. (Author)

A82-26178 # **Power generation from the East Australian current by use of arrays of submerged Darrieus vertical axis turbines.** K. D. Thomson (Defence Research Centre, Salisbury, Australia). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 35-38. 9 refs.

A82-26216 # **Diffuser-augmented wind turbine analysis.** C. A. J. Fletcher (Sydney, University, Sydney, Australia). In: Australasian Conference on Hydraulics and Fluid Mechanics, 7th, Brisbane, Australia, August 18-22, 1980, Preprints of Papers. Barton, Australia, Institution of Engineers, 1981, p. 435-438. 9 refs. Research supported by the National Energy, Research, Development, and Demonstration Council.

The performance of diffuser-augmented wind turbines has been established by matching the forces acting on a blade element to overall momentum and energy balances. This permits the radial variation, wake rotation and Reynolds number effects on the turbine blades to be taken into account. Good agreement with experimental data is obtained for both turbines and turbine-simulating screens. Optimising the pitch setting to take account of the total drag as well as the power output indicates that a substantial drag reduction with only a small loss of power output is possible; this is relevant to jet-stream electricity generation. (Author)

A82-26614 **Design and performance of a small shrouded Cretan windwheel.** P. D. Fleming and S. D. Probert (Cranfield Institute of Technology, Cranfield, Beds., England). *Applied Energy*, vol. 10, Feb. 1982, p. 121-139. 22 refs. Research supported by the Science and Engineering Research Council.

Test data for the performance of a shrouded Cretan-type sail mill are reported. The mill was chosen because of simplicity and low-cost considerations, for applications in developing countries. The mill had 9 sails, a 0.64 m diam cycle wheel as a rotor, and was tested in rim-attached and sail-with-pole configurations. Winds shape the sails into airfoil shapes, and the addition of the shroud to augment the wind flow boosted the power coefficient to close to the Betz limit. The sail-with-pole form, comprising a loosely sheeted sail with the leading edge wrapped around the spoke and fastened to itself was found to be a practical configuration for driving a peristaltic pump. Maximum power was obtained with a higher rotor speed than the rotor speed for maximum torque. Prospective uses for the shrouded sail mill are given as irrigation and land drainage, and for boosting the thermo-syphon in a domestic solar heating circuit. M.S.K.

A82-26769 † **Increasing the dielectric strength of interelectrode inserts in an MHD generator channel by air injection (Pro pidvishchennia elektrichnoi mitsnosti mizhelektrodnoi vstavki kanalu MGD-generatora vduvom povitria).** E. T. Bazaev, N. I. Mazur, A. A. Miroshnichenko, and G. M. Schogolev (Akademiia Nauk Ukrains'koi RSR, Institut Tekhnichnoi Teplofiziki and Institut Elektrodinamiki, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Matematichni ta Tekhnichni Nauki*, Feb. 1982, p. 71-73. 7 refs. In Ukrainian.

Interelectrode insulating inserts have been tested in the plasma dynamic channel of an MHD generator with and without air injection. It is found that the dielectric strength of inserts thermally protected by air injection is higher than that of inserts without air injection, with only a slight resistance drop (no more than 1% for commercial MHD channels). V.L.

A82-28024 **EURELIOS, the world's first thermo-mechanical helioelectric power plant.** J. Gretz (European Economic Community, Helioelectric Power Plant EURELIOS, Adrano, Italy). *Endeavour*, vol. 6, no. 1, 1982, p. 34-39. 8 refs.

Characteristics of the power source, design, costs and operating mechanisms and performance of the EURELIOS central receiver solar electric power plant are described. Noting that the solar input at the earth's surface is about 1 kW/sq m, 6200 sq m of float glass mirrors mounted on 182 heliostats were fabricated to focus the incoming radiation onto a receiver aperture atop a 55 m high tower. The curved mirrors permit the focus of 80% of the energy input to be deposited on a 2.2 m diam aperture which is equipped with heat exchangers imbedded in pyrex and darkened and finned to maximize absorption. Feedwater is superheated in the receiver and is transferred to a buffer tank of hot water at 19 bar and molten salt at 410 C, and then on to turbines for actual power production. The grid

serves as back-up power system. Total costs are calculated at $1600/kWe. M.S.K.

A82-28313 **Precision casting for gas turbine engines.** C. W. Foster (Rolls-Royce, Ltd., London, England). *Aircraft Engineering*, vol. 54, Feb. 1982, p. 11-14.

The paper describes the gas turbine casting process in detail. High-temperature creep resistance is the property whose desirability most advances casting and materials technology. Vacuum melting and casting, directionally solidified (DS) casting, equi-axed and single-crystal casting are major developments in the progress of this technology. The vacuum process was used in the RB211-524 engine, while the DS process was employed in more advanced engines of the RB series. Rolls-Royce has built a new demonstration furnace whose melting unit, furnace chamber, withdrawal chamber, vacuum system, casting cycle, and control system are described. The future will bring increasing use of automation, production of more cast-to-size features, single-crystal castings application and process developments that will produce complex internal cooling configurations that are impossible today. C.D.

A82-28537 # **Harnessing wind power.** J. Fagenbaum, *Mechanical Engineering*, vol. 104, Apr. 1982, p. 64-73. 18 refs.

The design goals, test results, operating mechanisms, and ultimate limits of large wind energy conversion systems (WECS) are explored. NASA is currently managing and monitoring the performance of the Mod O, Mod OA, Mod 1, and Mod 2 wind turbines, which produce from 100 kW-2.5 MWe for grid interconnection. The Mod 2 machines have a 300 ft diam rotor, begin producing at 14 mph and achieve the rated output at 20 mph. Testing has shown the necessity of incorporating partial span pitch control, a flexible shaft, yaw control, microprocessor monitored wind condition sensors, and a soft-shell tower to lower vibration hazards with WECS. Large WECS have proved to be relatively nonpolluting, although some television and radio interference is present. Institutional issues for the protection of land, of aircraft flight paths, and for utility interconnect are outlined, and large WECS development programs in Denmark, Sweden, Spain, and Germany are described. M.S.K.

N82-16478*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VARIABLE GAIN FOR A WIND TURBINE PITCH CONTROL Final Report
Robert C. Seidel and Arthur G. Birchenough Dec. 1981 14 p refs
(Contract DE-AI01-76ET-20320)
(NASA-TM-82751; DOE/NASA/20320-34; E-1067) Avail: NTIS HC A02/MF A01 CSCL 10A

The gain variation is made in the software logic of the pitch angle controller. The gain level is changed depending upon the level of power error. The control uses low gain for low pitch activity the majority of the time. If the power exceeds ten percent offset above rated, the gain is increased to a higher gain to more effectively limit power. A variable gain control functioned well in tests on the Mod-0 wind turbine. T.M.

N82-16481*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY AND EVALUATION OF THE CONCEPTUAL DESIGN STUDY OF A POTENTIAL EARLY COMMERCIAL MHD POWER PLANT (CSPEC) Final Report
P. J. Staiger and P. F. Penko Jan. 1982 22 p refs
(Contract DE-AI01-77ET-10769)
(NASA-TM-82734; DOE/NASA/10769-21; E-1046) Avail: NTIS HC A02/MF A01 CSCL 10B

The conceptual design study of a potential early commercial MHD power plant (CSPEC) is described and the results are summarized. Each of two contractors did a conceptual design of an approximately 1000 MWe open-cycle MHD/steam plant with oxygen enriched combustion air preheated to an intermediate temperature in a metallic heat exchanger. The contractors were close in their overall plant efficiency estimates but differed in their capital cost and cost of electricity estimates, primarily because of differences in balance-of-plant material, contingency, and operating and maintenance cost estimates. One contractor concluded that its MHD plant design compared favorably in cost of electricity with conventional coal-fired steam plants. The other contractor is making such a comparison as part of a follow-on study. Each contractor did a preliminary investigation of part-load performance and plant availability. The results of NASA studies investigating the effect of plant size and oxidizer preheat temperature on the performance of CSPEC-type MHD plants are also described. The efficiency of a 1000 MWe plant is about three points higher than of a 200 MWe plant. Preheating to 1600 F gives an efficiency about one and one-half points higher than preheating to 800 F for all plant sizes. For each plant size and preheat temperature there is an oxidizer enrichment level and MHD generator length that gives the highest plant efficiency. B.W.

N82-16483*# Engelhard Industries, Inc., Edison, N.J. Industries Div.
DEVELOP AND TEST FUEL CELL POWERED ON-SITE INTEGRATED TOTAL ENERGY SYSTEMS. PHASE 3: FULL-SCALE POWER PLANT DEVELOPMENT Quarterly Report, May - Jul. 1981
25 Aug. 1981 35 p refs
(Contracts DEN3-241; DE-AI01-80ET-17088)
(NASA-CR-165455; DOE/NASA/0241-2; QR-2) Avail: NTIS HC A03/MF A01 CSCL 10B

A schematic and physical layout is given for the 5kW integrated system and the development status of individual components is described. The results of using a one dimensional mathematical model of the 5kW reformer are presented. Plans for a single-tube reformer test unit for the acquisition of temperature profile data are described. Tentative specifications for a 50kW dc-to-ac inverter are listed. Performance data are given on two 3-cell stacks incorporating semiautomatic acid replenishment systems and improved electrocatalysts. A qualification test on methanol/steam reforming catalyst T2107RS is reported, including a portion in which the catalyst was deliberately poisoned with 800 ppm ethanol in the feed. Author

N82-16485*# Ford Motor Co., Dearborn, Mich.
ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM INITIAL DEVELOPMENT REPORT Progress Report, 20 May - 24 Sep. 1979
Aug. 1980 150 p Prepared in cooperation with AiResearch Mfg. Co., Phoenix, Ariz.
(Contract DEN3-37)
(NASA-CR-165130; DOE/NASA/0037-80/2; DDA-ADR-10086) Avail: NTIS HC A07/MF A01 CSCL 10B

The powertrain consists of a single shaft regenerated gas turbine engine utilizing ceramic hot section components, coupled to a slit differential gearbox with an available variable stator torque converter and an available Ford intergral overdrive four-speed automatic transmission. Predicted fuel economy using gasoline fuel over the combined federal driving cycle (CFDC) is 15.3 km/1, which represents a 59% improvement over the spark-ignition-powered baseline vehicle. Using DF2 fuel, CFDC mileage estimates are 17.43 km/1. Zero to 96.6 km/hr acceleration time is 11.9 seconds with a four-second acceleration distance of 21.0 m. The ceramic radial turbine rotor is discussed along with the control system for the powertrain. T.M.

N82-16495*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE NASA LEWIS LARGE WIND TURBINE PROGRAM
R. L. Thomas and D. H. Baldwin 1981 24 p refs Presented at the 5th Biennial Wind Energy Conf. and Workshop, Washington, D.C., 5-7 Oct. 1981
(Contract DE-AI01-79ET-20305)
(NASA-TM-82761; DOE/NASA/20305-7; E-1082) Avail: NTIS HC A01/MF A01 CSCL 10B

The program is directed toward development of the technology for safe, reliable, environmentally acceptable large wind turbines that have the potential to generate a significant amount of electricity at costs competitive with conventional electric generation systems. In addition, these large wind turbines must be fully compatible with electric utility operations and interface requirements. Advances are made by gaining a better understanding of the system design drivers, improvements in the analytical design tools, verification of design methods with operating field data, and the incorporation of new technology and innovative designs. An overview of the program activities is presented and includes results from the first and second generation field machines (Mod-OA, -1, and -2), the design phase of the third generation wind turbine (Mod-5) and the advanced technology projects. Also included is the status of the Department of Interior WTS-4 machine.
T.M.

N82-16522# Power Technologies, Inc., Schenectady, N. Y.
DYNAMICS OF SINGLE- AND MULTI-UNIT WIND-ENERGY CONVERSION PLANTS SUPPLYING ELECTRIC UTILITY SYSTEMS
E. N. Hinrichsen and P. J. Nolan Aug. 1981 141 p refs
(Contract DE-AC01-78ET-20466)
(DE82-000666; DOE/ET-20466/78/1) Avail: NTIS HC A07/MF A01

The development of large wind turbine generators (WTGs) and their integration into electric power systems is accelerating. Since wind is neither as steady nor as dense a form of energy as steam or water, wind turbine generators differ greatly in construction and operation from steam and hydro turbine generators. The dynamic behavior of WTGs connected to utility power systems, was examined.
DOE

N82-16525# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
ENERGY EXCHANGER PERFORMANCE AND POWER CYCLE EVALUATION, EXPERIMENTS AND ANALYSIS Final Report, 23 May 1978 - 31 Dec. 1980
W. J. Thayer, III, Robert T. Taussig, John F. Zumdieck, Thinium S. Vaidyanathan, and Walter H. Christiansen Apr. 1981 161 p refs
(Contract DE-AC06-78ER-01084)
(DE82-001069; DOE/ER-01084/T1) Avail: NTIS HC A08/MF A01

The energy exchanger, or pressure exchanger, is a rotating, axial flow machine which utilizes unsteady gasdynamic processes to directly transfer work between two gas streams. A program which has provided technology required for the development of efficient energy exchangers for power operation applications is described. The program contains three major elements: testing of a laboratory scale device; development of an energy exchanger flow model, and analysis of potential applications in advanced power generation cycles. The test energy exchanger was developed and tested over a range of operating conditions. This device transferred approximately 100 kW of mechanical power between two gas streams by simultaneously expanding one stream and compressing the other through pressure ratios of approximately 2.5. The efficiency of this transfer process was as high as 74%.
DOE

N82-16547# FDO Technische Adviseurs B.V. (Netherlands).
EXCHANGE OF NATIONAL EXPERIENCE IN THE FIELD OF NEW ENERGY SOURCES: IN PARTICULAR, SOLAR, WIND, AND GEOTHERMAL ENERGY: THE 25 m EXPERIMENTAL HORIZONTAL AXIS WIND TURBINE (25 m HAT)
G. B. Geerdink Oct. 1980 19 p Presented at the Sem. on Technol. Related to New Energy Sources, Juelich, West Germany, 8-12 Dec. 1980; sponsored by the Senior Advisers to ECE Governments on Science and Technology Sponsored by the Government of the Netherlands Prepared for the United Nations Economic Commission for Europe
(PB81-239568; UN-ECE-SC-TECH-SEM-7-R-6) Avail: NTIS HC A02/MF A01 CSCL 10B

The design of the wind generator, its rotor's capabilities, electricity generated, safety, various loadings, and instrumentation are discussed. Overall dimensions and weight of comments, the characteristics of the electrical system, of the yard mechanism and others are given in detail, including photos, drawings and graphs.
GRA

N82-16900# Argonne National Lab., Ill.
MHD HEAT AND SEED RECOVERY TECHNOLOGY PROJECT Quarterly Report, Oct. - Dec. 1980
Michael Petrick and Terry R. Johnson Jul. 1981 45 p refs
(Contract W-31-109-eng-38)
(DE82-001608; ANL/MHD-81-1; QR-12) Avail: NTIS HC A03/MF A01

Experimental investigations are being conducted or planned in the following of critical problem areas: (1) corrosion and erosion of refractories and metal alloys; (2) NO/sub x/ behavior in the radiant boiler and secondary combustor; (3) radiant boiler design to meet the multiple requirements of steam generation, NO/sub x/ decomposition, and seed-slag separation; (4) effects of solid or liquid seed deposits on heat transfer and gas flow in the steam and air heaters; (5) formation, growth, and deposition of seed-slag particles, and (6) character of the combustion gas effluents.
DOE

N82-16901# Argonne National Lab., Ill. Engineering Div.
TECHNICAL SUPPORT FOR OPEN-CYCLE MHD PROGRAM Progress Report, Jan. - Mar. 1980
G. F. Berry, ed. Jul. 1981 110 p refs
(Contract W-31-109-eng-38)
(DE82-001955; ANL/MHD-80-6) Avail: NTIS HC A06/MF A01

The development of analytical tools needed for investigating the performance of the major components in the combined cycle MHD/steam power system is described. The analytical effort is centered on the primary components of the system that are unique to MHD and, also, on the integration of these analytical models into a model for the entire power producing system. The present project activities include modeling of the secondary combustor, generator, radiant boiler, and formation and decomposition of NO. The results of preliminary off design studies and of system optimization studies are presented, and analysis of the U-25B generator performance, which was done in support of the proposed test plan, is included. Refinements and improvements in the MHD systems code and executive program are considered.
DOE

N82-16937*# AiResearch Mfg. Co., Phoenix, Ariz.
ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM DEVELOPMENT FOR AUTOMOTIVE APPLICATIONS Progress Report, Oct. 1979 - Jun. 1980
Nov. 1980 431 p refs
(Contract DEN3-167)
(NASA-CR-165175; DOE/NASA/0167-80/1; AiResearch-31-3725; PR-1) Avail: NTIS HC A19/MF A01 CSCL 13F

Progress in the development of a gas turbine engine to improve fuel economy, reduce gaseous emissions and particulate levels, and compatible with a variety of alternate fuels is reported. The powertrain is designated AGT101 and consists of a regenerated single shaft gas turbine engine, a split differential gearbox and a Ford Automatic Overdrive production transmission. The powertrain is controlled by an electronic digital microprocessor and associated actuators, instrumentation, and sensors. Standard automotive accessories are driven by engine power provided by an accessory pad on the gearbox. Component/subsystem development progress is reported in the following areas: compressor, turbine, combustion system, regenerator, gearbox/transmission, structures, ceramic components, foil gas bearing, bearings and seals, rotor dynamics, and controls and accessories.
J.M.S.

N82-17180# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
INFLUENCE OF CORRELATIONS AND COMPUTATIONAL METHODS ON THE PREDICTION OF OVERALL EFFICIENCY
In its Through Flow Calculations in Axial Turbomachines Oct. 1981 p 29-31 refs

Avail: NTIS HC A15/MF A01

The process of designing a gas turbine or a steam turbine begins with an evaluation of the influence of component design parameters on the overall cost. For both the steam turbine and

the gas turbine, energy costs are rapidly increasing and component efficiency is therefore a primary design objective. For the aircraft gas turbine, the weight of the component influences the fuel consumption and is therefore also an important energy cost consideration. Turbine efficiency predictions, together with information which influence the weight and cost, were obtained from flow field calculations which define the thermodynamic properties and velocity triangles throughout the turbine. These computational methods may be full span through flow calculations which predict the fluid properties from the hub to the tip between each blade row or they may be mean line calculations. In either case they are dependent upon loss and deviation models for their effectiveness in the efficiency optimization stage of the design process. The loss and deviation correlations which are in common use by steam turbine and gas turbine manufacturers are frequently developed internally and are maintained as proprietary information. The overall efficiency predictions which are discussed are therefore limited to results obtained using the correlations built into the methods which are described. T.M.

N82-17203# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
HELICOPTER PROPULSION SYSTEMS
Sep. 1981 277 p refs Partly in ENGLISH, partly in FRENCH Meeting held in Toulouse, 11-14 May 1981
(AGARD-CP-302; ISBN-92-835-0299-X) Avail: NTIS HC A13/MF A01

Component technology for turboshaft engines and transmissions, inlet protection systems, engine-airframe dynamic compatibility, and future requirements are described. For individual titles, see N82-17204 through N82-17225.

N82-17204# Textron Bell Helicopter, Fort Worth, Tex.
HELICOPTER PROPULSION SYSTEMS: PAST, PRESENT AND FUTURE
Robert R. Lynn and Gordon E. Holbrook *In* AGARD Helicopter Propulsion Systems Sep. 1981 12 p refs

Avail: NTIS HC A13/MF A01

Helicopter propulsion systems are reviewed, and it is noted that helicopter development is paced to a major extent by the power plant. Power available, reliability, fuel consumption, power-to-weight ratio, and life cycle costs are key parameters. The application of emerging technologies such as microelectronics, ceramics and other new materials and approaches, and the continuing refinement of the aerodynamics and dynamics of gas turbine power plants are discussed and noted to result in a significant benefit to the helicopter and its operator. Important airframe-propulsion system interface requirements are given, and the need is discussed for new innovative certification procedures that provide for emergency operation with acceptable economics. Finally, future propulsion system capabilities are projected and their dramatic benefit for the helicopter noted. Author

N82-17206# Rolls-Royce Ltd., Leavesden (England).
MECHANICAL ADVANCES IN THE DESIGN OF SMALL TURBOSHAFT ENGINES
J. Dominy and K. J. Hart *In* AGARD Helicopter Propulsion Systems Sep. 1981 12 p

Avail: NTIS HC A13/MF A01

Mechanical components have a significant influence on the efficiency of a small gas turbine engine. Some of the performance losses associated with the design of the power transmission and internal air system are defined and discussed. Improvements in engine efficiency must be considered in conjunction with cost, reliability and size or weight. Many of the problems considered are applicable to gas turbines in general but become acute in small engines due to the adverse effects of scale on many components design parameters. To meet the increasing demand for more efficient powerplants the mechanical research engineer must improve the analysis of mechanical component behavior to produce optimized engine designs. Author

N82-17211# Avco Lycoming Div., Stratford, Conn. Preliminary Design and Advanced Programs.
AERODYNAMIC COMPONENTS FOR SMALL TURBOSHAFT ENGINES
J. W. Schrader and W. F. Schneider *In* AGARD Helicopter Propulsion Systems Sep. 1981 15 p

Avail: NTIS HC A13/MF A01

Future developments of advanced helicopter engines are projected from an aerothermodynamic viewpoint. Cycles for engines aiming at lower specific fuel consumption, improved power lapse rates, and implementation of contingency ratings are discussed. These cycles include nonregenerative and regenerative cycles. Design trends are presented for the major engine aerodynamic components. Author

N82-17459# Open Univ., Milton (England). Energy Research Group.
EVALUATION OF THE DESIGN, CONSTRUCTION AND OPERATION OF A GAS FUELED ENGINE DRIVEN HEAT PUMP
C. A. Phillips Jan. 1981 76 p refs
(ERG-034) Avail: NTIS HC A05/MF A01

The design, construction, testing, and evaluation of a gas fueled engine driven heat pump are considered. The heat pump, using air as its source of heat is driven by a 360 cc single cylinder marine engine converted to run on natural gas. The unit was built, installed in a laboratory, and underwent intensive performance testing. The heat pump works well and justifies the design assumptions made, having allowed for a poor performance from the particular engine used. At 6 C (ambient) an output of 14 kW with an overall efficiency or C.O.P. (total heat output/gas input) of 1.1 was achieved. Results compare favorably with a seasonal efficiency of a gas boiler of around 0.65 to 0.70. J.M.S.

N82-17536# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Drehfluegler und Verkehr.
STRESS ANALYSIS AND TEST PHILOSOPHY FOR WIND ENERGY CONVERTER BLADES
H. Bansemir and K. Pfeifer 1980 28 p Presented at 4th Meeting of Experts on Rotor Blade Technol. with Special Respect to Fatigue Design Probl., Stockholm, 21-22 Apr. 1980
(NBB-UD-300-80-0) Avail: NTIS HC A03/MF A01

Projected wind energy converter blades for a 5MW plant are described and analyzed. The calculation of laminate cross-section properties as well the overall behavior of the blade is considered. Special attention is given to the bolted area and to the compression stresses in the blade, because it is mainly loaded by bending moments. Tests performed in order to obtain basic data of the materials used in the design are discussed. Special components such as the bolted area are tested by static and dynamic loads. Finally the strains in the entire blade under load and the eigenfrequencies are measured. A.R.H.

N82-17606*# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
OVERVIEW STUDY OF SPACE POWER TECHNOLOGIES FOR THE ADVANCED ENERGETICS PROGRAM
R. Taussig, S. Gross, A. Millner, M. Neugebauer, W. Phillips, J. Powell, E. Schmidt, M. Wolf, and G. Woodcock Oct. 1981 341 p refs
(Contract NAS3-22477)
(NASA-CR-165269; MSNW-1169) Avail: NTIS HC A15/MF A01 CSCL 10B

Space power technologies are reviewed to determine the state-of-the-art and to identify advanced or novel concepts which promise large increases in performance. The potential for increased performance is judged relative to benchmarks based on technologies which have been flight tested. Space power technology concepts selected for their potentially high performance are prioritized in a list of R & D topical recommendations for the NASA program on Advanced Energetics. The technology categories studied are solar collection, nuclear power sources, energy conversion, energy storage, power transmission, and power processing. The emphasis is on electric power generation in space for satellite on board electric power, for electric propulsion, or for beamed power to spacecraft. Generic mission categories such as low Earth orbit missions and geosynchronous orbit missions are used to distinguish general requirements placed on the performance of power conversion technology. Each space power technology is judged on its own merits without reference to specific missions or power systems. Recommendations include 31 space power concepts which span the entire collection of technology categories studied and represent the critical technologies needed for higher power, lighter weight, more efficient power conversion in space. Author

N82-17615*# Stonehart Associates, Inc., Madison, Conn.

PREPARATION AND EVALUATION OF ADVANCED ELECTROCATALYSTS FOR PHOSPHORIC ACID FUEL CELLS Quarterly Report, Oct. - Dec. 1981

Paul Stonehart, John Baris, John Hochmuth, and Peter Pagliaro Dec 1981 44 p

(Contract DEN3-176; Contract DE-AI03-80ET-17088)

(NASA-CR-165594; DOE/NASA/0176-81/5; QR-8) Avail: NTIS HC A03/MF A01 CSCL 10A

Two cooperative phenomena are required the development of highly efficient porous electrocatalysts: (1) is an increase in the electrocatalytic activity of the catalyst particle; and (2) is the availability of that electrocatalyst particle for the electromechanical reaction. The two processes interact with each other so that improvements in the electrochemical activity must be coupled with improvements in the availability of the electrocatalyst for reaction. Cost effective and highly reactive electrocatalysts were developed. The utilization of the electrocatalyst particles in the porous electrode structures was analyzed. It is shown that a large percentage of the electrocatalyst in anode structures is not utilized. This low utilization translates directly into a noble metal cost penalty for the fuel cell. E.A.K.

N82-17617# Kernforschungsanlage, Juelich (West Germany).

IMPLEMENTING AGREEMENT FOR A PROGRAM OF RESEARCH AND DEVELOPMENT ON WIND ENERGY CONVERSION SYSTEMS

Apr. 1981 109 p refs Partly in ENGLISH and GERMAN Presented at 1981 Meeting of Experts of Annex 3 and 3a on Integration of Wind Power into Natl. Elec. Supply Systems, Regensburg, West Germany, 29-30 Jan. 1981 Sponsored by Bundesministerium fuer Forschung und Technol. and Regensburg Univ., West Germany

(Juel-Spez-108; ISSN-0343-7639) Avail: NTIS HC A06/MF A01

The technical and economic feasibility of wind power electric generation in Germany and the Netherlands is discussed. Problems of power output fluctuations are considered. For individual titles, see N82-17618 through N82-17625.

N82-17621# Regensberg Univ. (West Germany). Forschungsprojekt Windenergie.

ASSESSMENT OF THE POTENTIAL OF LWECS IN THE NETHERLANDS

W. Dub *In* Kernsforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 41-62 refs

Avail: NTIS HC A06/MF A01

The potential of large wind energy conversion systems (LWECS) in the Netherlands is assessed. Hourly data on mean wind speeds and wind directions from 5 stations are analyzed and extrapolated up to a height of 100 m and monthly and annual mean wind speeds. The wind power conversion efficiency of wind turbines and the monthly and annual energy production of WECS 1 are calculated. The daily wind energy production of a compound system of 3 MW wind turbines and the daily percentages of the 1980 national electric power needs they would meet are determined using 1975 wind data. The number of 3 MW and 0.8 MW wind turbines required to produce 9.97 TWh per year is determined. J.D.H.

N82-17622# Regensberg Univ. (West Germany). Forschungsprojekt Windenergie.

POWER FLUCTUATIONS: TECHNICAL AND STATISTICAL ASPECTS

H. Pape *In* Kernsforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 63-70 refs

Avail: NTIS HC A06/MF A01

Electric power output fluctuations from wind turbines occurring within minutes are considered. Means of regulating the fluctuations are discussed. A statistical proof that an increasing number of wind turbines tends to generate a more regular power output than each individual wind turbine is presented. J.D.H.

N82-17623# Regensberg Univ. (West Germany). Forschungsprojekt Windenergie.

FORECASTING WIND POWER OUTPUT

W. Dub *In* Kernsforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 71-80 refs

Avail: NTIS HC A06/MF A01

Long term forecasts of electric energy output from wind power are presented. Periods of 2-6 hours, 6-12 hours, 12-24 hours, and 24-48 hours are considered. The prediction of wind speed is discussed. It is determined that, having a good estimator of the mean wind speed V sub T for a planning period T, the mean wind power output will be underestimated, so long as the wind speed used is the range of cut-in and rated speeds. J.D.H.

N82-17624# Regensberg Univ. (West Germany). Forschungsprojekt Windenergie.

ASSURED LOAD CARRYING CAPABILITY AND CAPACITY CREDIT

H. Pape *In* Kernsforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 81-95 refs

Avail: NTIS HC A06/MF A01

The determination of assured load carrying capability and the capacity credit for use in planning windpowered electric generation facilities is considered. Calculation of the available capacity of thermal power plants is described and compared with calculation of available capacity for wind turbines, taking into account outages caused by the unavailability of the primary energy, wind. The assured load carrying capability of power plants is defined. An operational definition of the capacity credit of wind turbines as related to a fixed time t Epsilon T is presented and extended to the period T. J.D.H.

N82-17625# Gesamthochschule, Kassel (West Germany). Fachbereich Elektrotechnik.

POSSIBILITIES FOR AVOIDING STRONG VARIATIONS OF THE ELECTRICAL OUTPUT POWER OF WIND ENERGY SYSTEMS [MOEGLICHKEITEN ZUR VERMEIDUNG VON STARKEN SCHWANKUNGEN DER ELEKTRISCHEN ABGABELEISTUNG VON WINDENERGIEANLAGEN]

G. Cramer *In* Kernsforschungsanlage Implementing Agreement for a Program of Res. and Develop. on Wind Energy Conversion Systems Apr. 1981 p 96-99 refs

Avail: NTIS HC A06/MF A01

The conversion of the kinetic energy of wind into electric power through wind powered converters by the primary energy of atmospheric circulation speed is discussed. It is suggested that wind powered generators which work with the supply network should avoid overloading the installation from wind performance caused by a fast change of the blade pitch. There are possibilities to achieve numerical comparison of the temporary storage performance of kinetic energy by application of rotating masses with flywheels, which allow for rotation speed variations. Through the feed of direct or alternate current in the rotor cycle form asynchronic machines with slip rings or through the influence of the slip performance a speed of variable duty on the network is accomplished. E.A.K.

N82-17637# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamic.

STATIC AND DYNAMIC INVESTIGATIONS OF DIFFERENT TOWERS FOR WIND TURBINES Final Report

J. H. Argyris and K. A. Braun 1980 125 p refs Transl. into ENGLISH of "Statische und dyn. untersuch. verschiedener tuerme fuer windturbinen" Rept. ISD-261 Stuttgart Univ., Stuttgart, 1979 122p Original report in GERMAN previously announced as N81-12628 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-274; ISD-261; ISSN-0170-6071) Avail: NTIS HC A06/MF A01

The kinematics of a cantilevered, a conventional guyed, and a compliant (elastic column held by a rigid framework) tower were studied. The static layout of the towers is established, using the reactions due to different gusts which a two-bladed rotor (120 m diameter) imposes on a rigid support as external loads. The rotor blades are assumed to be inelastic. Each one has a flapping hinge and a flap-pitch coupling. Dynamic responses were calculated by the finite element method. The guyed tower is superior to the cantilevered one. A 10.4 deg inclination angle seems best for the compliant tower, but more dynamic and

stability analyses are needed before undertaking further tower geometry optimization. Author (ESA)

N82-17638# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

ROTOR MODEL FOR THE VERIFICATION OF COMPUTATIONAL METHODS Final Report

J. H. Argyris, W. Aicher, F. Karl, W. Kuemmerle, and M. Mueller 1980 66 p refs Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-275; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

A windmill rotor model with 7.3 m rotor diameter was constructed in order to test a data acquisition/transmission system and computational models. Data, e.g., strains, angles, linear movements, accelerations, are measured at the rotor, digitized, and transmitted optoelectronically. Measurements of rotor blade dynamic response to cyclic gravity loading are compared with theoretical values. Deviation between measurements and calculations is 11%. Author (ESA)

N82-17639# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

STATIC INVESTIGATIONS OF ROTOR BLADES UNDER DEADWEIGHT AND DURING STATIONARY OPERATION Final Report

J. H. Argyris, K. A. Braun, and B. Kirchgaessner 1980 62 p refs Transl. into ENGLISH of "Statische untersuch. von rotorblaettern unter eigengewicht und im stationaeren betrieb" Rept. ISD-243 Stuttgart Univ., Stuttgart, 1979 57 p Original report in GERMAN previously announced as N82-17639 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-269; ISD-243; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

Several rotorblades of a horizontal axis windmill are studied both nonoperating under deadweight and under quasi-stationary loading with constant forces at rated operation, the blades of which have flap and lead-lag freedom as well as flap-pitch coupling. With a suitable mass distribution it is possible to reduce the blade bending moments in the flap direction drastically. The use of aircraft construction materials is considered. Carbon fiber reinforced plastic is the most suitable. Most of the blade models are investigated without lag hinge. The coning angle of rated operation assumed for the layout is reduced considerably for the blade models with lead-lag freedom in order to obtain sufficient centrifugal stiffness in the lag direction. Author (ESA)

N82-17640# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

STABILITY AND RESPONSE TO GRAVITY OF THE FLAP LAG MOTION FOR A RIGID ROTOR BLADE WITH FLAP-PITCH COUPLING Final Report

J. H. Argyris and B. Kirchgaessner 1980 59 p refs Transl. into ENGLISH of "Stabilitaet und schwerkraftresponse der schlag-schwenkbewegung eines starren rotorblattes mit blattwinkelrueckssteuerung" Rept. ISD-244 Stuttgart Univ., Stuttgart, 1979 80 p Original report in GERMAN announced as N80-30949 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-270; ISD-244; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

The coupled flap lag motion of a single, rigid rotor blade of a wind energy converter with flap and lag hinges and a coupling of the angle of attack with the flap motion is investigated. The equations of motion are developed under the assumption of linearized quasi-stationary aerodynamic forces. Static and dynamic stability of the coupled flap and lag motion are investigated. The equations are integrated for different cases under cyclic gravitational forces in order to estimate the importance of nonlinear terms and of the error resulting from the linearization of the conservative system. The nonlinear terms can be neglected, as can the effects of cyclic stiffness resulting from gravitational force. Results for nonlinearities arising from aerodynamic forces are inconclusive. Author (ESA)

N82-17641# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

DYNAMIC ANALYSIS OF A ROTOR BLADE WITH FLAP AND LAG FREEDOM AND FLAP-PITCH COUPLING Final Report

J. H. Argyris, K. A. Braun, and B. Kirchgaessner 1980 103 p refs Transl. into ENGLISH of "Dyn. anal. eines rotorblattes mit schlagfreiheit, schwenkreiheit u. blattwinkerlueckssteuerung" Rept. ISD-258 Stuttgart Univ., Stuttgart, 1979 95 p Original report in GERMAN previously announced as N80-30950 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-271; ISD-258; ISSN-0170-6071) Avail: NTIS HC A06/MF A01

For a windmill rotor blade, a linearized system of differential equations of motion is developed, using a finite element idealization of linearized quasi-stationary aerodynamic forces. Constant rotational speed and a rigidly supported hub are assumed. For two rotor blade models, which differ only in their stiffness in lag direction, the complex eigenfrequencies are calculated. The dynamic response of the rotor blades is computed for cyclic gravity loads at rated operation, for a gust, and, in one case, for the tower wake. From the deformation of the structure the stresses at selected points along the blade are calculated. Torque and rotor thrust are determined for one model. Additional stiffness improves stability and lead-lag angles. The coning angle is excellently stabilized by the flap-pitch coupling. Author (ESA)

N82-17642# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

STATIC AND DYNAMIC INVESTIGATIONS FOR THE MODEL OF A WIND ROTOR Final Report

J. H. Argyris, K. A. Braun, B. Kirchgaessner, and R. Walther 1980 71 p refs Transl. into ENGLISH of "Statische und dyn. untersuch. and einem windrotormodell" Rept. ISD-259 Stuttgart Univ., Stuttgart, Jun. 1979 69 p Original report in GERMAN previously announced as N81-12626 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-272; ISD-259; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

A wind rotor was constructed in order to test a data acquisition/transfer system which collects experimental data from the operating model and displays it on a screen. The comparison between the experimental data and the model results is used to check the applied computation methods. The static and dynamic analyses of the rotor model are considered. An 11% difference between experimental and model results is shown. A response problem with variable stiffness in time which arose during the dynamic analysis is solved by setting the structural stiffness constant over small time intervals, diagonalizing the time interval considered and integrating. After integration the solutions of the generalized degrees of freedom are transformed back into the physical system, using the time interval eigenvectors.

Author (ESA)

N82-17643# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik.

LOADING CYCLES AND MATERIAL DATA FOR THE LAYOUT OF A WIND TURBINE OF SPECIAL HUB CONCEPT Final Report

J. H. Argyris and K. A. Braun 1980 38 p refs Transl. into ENGLISH of "Lastwechselzahlen und materialwerte fuer die auslegung einer windturbine spezieller nabenkonstruktion" Rept. ISD-260 Stuttgart Univ., Stuttgart, Jun. 1979 38 p Original report in GERMAN previously announced as N81-12627 Sponsored in cooperation with International Energy Agency

(Contract BMFT-ET-4086-A)

(ISD-273; ISD-260; ISSN-0170-6071) Avail: NTIS HC A03/MF A01

The number of loading cycles of a rotor blade was estimated in order to assess allowable blade stress. Fatigue strengths and allowable stresses are calculated for aeronautic construction materials. Using wind data, the number of starts and stops was estimated. With a guess for the number of revolutions necessary to reach stationary operation from standstill, the number of loading cycles was determined, using the blade aerodynamics. The number of operational hours gives the number of loading cycles for rated operation. Rotation speeds of 1.67 and 2 rad/sec are considered. For 1.67, the number of loading cycles during stationary operation = 2.06 x 10 to the 8th power; during starts and cut offs = 357,000. For 2 rad/sec, results are 2.47 x 10 to the 8th power and 463,000. Stress values, expressed in installed power/sqmm, are: aluminum alloy = 98; stainless steel = 294; glass fiber reinforced plastic = 98; and carbon fiber reinforced plastic = 147. Author (ESA)

N82-17646# World Meteorological Organization, Geneva

(Switzerland).

METEOROLOGICAL ASPECTS OF THE UTILIZATION OF WIND AS AN ENERGY SOURCE

1981 201 p refs

(WMO-575; ISBN-92-63-10575-8; WMO-TN-175) Avail: NTIS MF A01; print copy available at WMO, Geneva SwFr 40

The application of meteorological data and knowledge to the planning and operation of wind energy conversion systems (WECS) is discussed. The development of WECS and WMO activities related to energy matters, with special regard to wind energy, is reviewed. Atmospheric circulation systems of various scales, atmospheric turbulence, and the boundary layer are considered, including numerical models. Wind energy technology, i.e., the different types of wind machines (both small and large conversion systems) together with their usual possibilities of application, and the environmental impact of WECS, which should be kept in mind in the planning stage in order to reduce it to a minimum, are treated. As to wind energy meteorology, the requirements for, and the availability of, meteorological data for use in the exploratory, planning and operational phases of WECS are determined. The economic aspects of deciding on the establishment of wind energy systems are also indicated. A world map, illustrating the global distribution of wind energy potential is included. Author (ESA)

N82-18123# Tokyo Univ. (Japan).

AN EXTENSION OF THE LOCAL MOMENTUM THEORY TO THE ROTORS OPERATING IN TWISTED FLOW FIELD

Akira Azuma, Ken-ichi Nasu, and Takatoshi Hayashi *In* DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 19 p refs

Avail: NTIS HC A99/MF A01

The local momentum theory was developed to calculate the dynamic airloading of a helicopter rotor, where the velocity perpendicular to the plane of rotation was assumed to be negligibly low in comparison with the rotating velocity. In the case of propellers or windmills, however, this assumption is no longer adequate, and the flow field seen in the rotor-fixed-coordinate system is noticeably twisted along the span. In order to permit calculation of the induced velocity distribution as well as the airloading of the blade in such a twisted flow field, we have carried out an extension of the local momentum theory. Since our method of calculation is based on the instantaneous circulation distribution rather than the instantaneous momentum balance, it may be called the Local Circulation Method. The present method is also applicable to propellers and windmills in yawed flow. Author

N82-18127# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.

MODAL CHARACTERISTICS OF ROTOR BLADES: FINITE ELEMENT APPROACH AND MEASUREMENT BY GROUND VIBRATION TEST

D. Ludwig *In* DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 23 p refs

Avail: NTIS HC A99/MF A01

The mass and stiffness matrices for a rotating blade are established by the finite element method. The formulation is based on the Lagrange function for combined flapwise bending, chordwise bending, and torsion of twisted nonuniform rotor blades. The element matrices are created by the non-numeric computer program REDUCE. An ordering scheme was introduced to demonstrate which terms may be simplified or neglected. As examples, eigen analyses, with the finite element computer program, are performed for a homogeneous beam and for the nonrotating blade of a wind energy converter. The results of the calculations for the beam are compared with the analytical solutions. The rotor blade of the wind energy converter was tested in a ground vibration test. A short description of the ground vibration test technique and performance is given. N.W.

N82-18128# Hochschule der Bundeswehr, Munich. (West Germany). Inst. fuer Luftfahrttechnik und Leichtbau.

DYNAMIC AND AEROELASTIC CHARACTERISTICS OF COMPLETE WINDTURBINE SYSTEMS

E. W. Steinhardt *In* DGLR Seventh European Rotorcraft and Powered Lift Aircraft Forum 1981 16 p refs

Avail: NTIS HC A99/MF A01

For the investigation of the dynamic and aeroelastic characteristics of large horizontal axis windturbines, a hybrid model consisting of rigid bodies and flexible continuous structures was developed. Degrees of freedom include tower bending and torsion, pitch and yaw of the nacelle as well as rotation, inplane and out-of-plane bending of the blades. Aerodynamic forces are introduced with special regard to motion-induced effects and on gusts. A set of partial integro-differential equations was established via the principle of virtual work. The application of Galerkin's extended method gives a system of linear periodic differential equations. The numerical results confirm strong rotor-tower-coupling and illustrate the typical features of periodic systems. Instationary aerodynamic terms are found to be of minor importance and hingeless rotors will be damped better than teetering rotors, but tower and blade reactions to gravity and gusts are higher. Author

N82-18693*# Structural Composites Industries, Inc., Azusa, Calif.

DESIGN, EVALUATION, AND FABRICATION OF LOW-COST COMPOSITE BLADES FOR INTERMEDIATE-SIZE WIND TURBINES Final Report

Oscar Weingart Sep. 1981 210 p refs

(Contracts DEN3-100; DE-AI01-79ET-20320)

(NASA-CR-165342; DOE/NASA/0100-1; SCI-81520) Avail: NTIS HC A10/MF A01 CSCL 10A

Low cost approaches for production of 60 ft long glass fiber/resin composite rotor blades for the MOD-0A wind turbine were identified and evaluated. The most cost-effective configuration was selected for detailed design. Subelement and subscale specimens were fabricated for testing to confirm physical and mechanical properties of the composite blade materials, to develop and evaluate blade fabrication techniques and processes, and to confirm the structural adequacy of the root end joint. Full-scale blade tooling was constructed and a partial blade for tool and process tryout was built. Then two full scale blades were fabricated and delivered to NASA-LeRC for installation on a MOD-0A wind turbine at Clayton, New Mexico for operational testing. Each blade was 60 ft. long with 4.5 ft. chord at root end and 2575 lbs weight including metal hub adapter. The selected blade configuration was a three cell design constructed using a resin impregnated glass fiber tape winding process that allows rapid wrapping of primarily axially oriented fibers onto a tapered mandrel, with tapered wall thickness. The ring winder/transverse filament tape process combination was used for the first time on this program to produce entire rotor blade structures. This approach permitted the complete blade to be wound on stationary mandrels, an improvement which alleviated some of the tooling and process problems encountered on previous composite blade programs. Author

N82-18694*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ASSESSMENT OF STEAM-INJECTED GAS TURBINE SYSTEMS AND THEIR POTENTIAL APPLICATION

Robert J. Stochl Feb. 1982 21 p refs

(NASA-TM-82735; E-1047) Avail: NTIS HC A02/MF A01 CSCL 10B

Results were arrived at by utilizing and expanding on information presented in the literature. The results were analyzed and compared with those for simple gas turbine and combined cycles for both utility power generation and industrial cogeneration applications. The efficiency and specific power of simple gas turbine cycles can be increased as much as 30 and 50 percent, respectively, by the injection of steam into the combustor. Steam-injected gas turbines appear to be economically competitive with both simple gas turbine and combined cycles for small, clean-fuel-fired utility power generation and industrial cogeneration applications. For large powerplants with integrated coal gasifiers, the economic advantages appear to be marginal. T.M.

N82-18704# Ecole Polytechnique, Montreal (Quebec). Center de Developpement Technologique.

CALCULATION OF THERMODYNAMIC EQUILIBRIA IN THE CARBONATE FUEL CELL, VOLUME 1. TASK 1: BINARY TERNARY AND QUARTERNARY PHASE DIAGRAMS CONTAINING Li(+), Na(+), K(+), CO3(=), SO3(=) AND OH(-) Final Report

A. D. Pelton, C. W. Bale, P. L. Lin, M. L. Saboungi, and M. Blander 31 Aug. 1981 182 p refs Prepared in cooperation with Argonne National Lab. 2 Vol.

(Contract DE-AC02-79ET-15416)
(DE82-000690: DOE/ET-15416/2-Vol-1) Avail. NTIS HC A09/MF A01

All available phase diagram and thermodynamic data on the eighteen binary systems containing Li(), Na(), K(), SO4(2+), and OH(+) have been collected and critically assessed. A set of self consistent thermodynamic parameters describing the free energies of all known compounds, solid solutions, and liquid solutions in the binary systems has been formulated. The phase diagrams have been calculated, and estimated error limits of all diagrams are given. Fourteen ternary phase diagrams containing Li(), Na(), K(), SO4(2+), CO3(2+) and OH(+) have been calculated from the assessed data for their binary subsystems with the aid of the Conformal Ionic Solution Theory. Comparison with experimental data is made where experimental diagrams are available and small ternary parameters are added where necessary. All calculated ternary phase diagrams are presented as polythermal projections of liquidus surfaces, and estimated error limits are given for each system. DOE

N82-18705# Ecole Polytechnique, Montreal (Quebec). Centre de Development Technologique.
CALCULATION OF THERMODYNAMIC EQUILIBRIA IN THE CARBONATE FUEL CELL, VOLUME 2. TASK 2: EQUILIBRIA BETWEEN THE CARBONATE ELECTROLYTE AND THE C-H-O-S GAS PHASE. TASK 3: VAPOUR PRESSURES AND THE VOLITISATION OF THE ALKALI SPECIES Final Report
C. W. Bale, A. D. Pelton, J. Melancon, M. L. Saboungi, and M. Blander 31 Aug. 1981 72 p refs Prepared in cooperation with Argonne National Lab. 2 Vol.
(Contract DE-AC02-79ET-15416)
(DE82-000689: DOE/ET-15416/2-Vol-2) Avail: NTIS HC A04/MF A01

A complete thermodynamic analysis has been performed upon eleven selected fuel feeds obtained after various pretreatment processes. The equilibrium partial pressures of some 34 gaseous species have been computed for each of the fuels at the anode inlet and outlet (75% hydrogen utilization). The complex gaseous equilibria of the fuels have been graphically represented with the aid of Gibbs ternary C-H-O composition triangles. The influence of temperature and pressure upon carbon deposition in the anode compartment has been determined and graphically presented. The effect of water addition upon carbon formation and upon free hydrogen production has been evaluated. The influence of sulfur impurities upon the gaseous equilibria in both electrode compartments and upon the chemical stability of the Ni/NiO electrodes has been assessed. DOE

N82-18706# Westinghouse Research and Development Center, Pittsburgh, Pa.
HIGH-TEMPERATURE, SOLID-OXIDE-ELECTROLYTE FUEL-CELL POWER-GENERATING SYSTEM Quarterly Report, 1 Dec. 1980 - 28 Feb. 1981
22 Mar. 1981 60 p refs
(Contract DE-AC02-80ET-1709)
(DE82-002095: DOE/ET-17089/T2) Avail: NTIS HC A04/MF A01

Porous support tube work was directed at reducing the firing temperature, where electrically heated furnaces that enable better zone temperature control can be utilized. Work on the air electrode for the FEA cell design concentrated on modifying the lanthanum manganite, to enhance its conductivity while matching its thermal expansion to that of the other fuel cell components. The thermal expansion and electrical resistivity of La0 5Ca0 5MnO3 were determined. An initial FBA cell was fabricated. Although its performance was below that of the cells in the series cell stack arrangement, it did prove that fabrication of all fuel cell components (including the interconnection) can be accomplished in this cell design. Analytical measurements on an actual HTSOE cell stack resulted in the use of the differential resistance ((RADIAL)V/(RADICAL)I) to isolate voltage losses under operating conditions, envisaged for the HTSOE fuel cell generator. DOE

N82-18719# Aeronautical Research Inst. of Sweden, Stockholm.
A TWO DIMENSIONAL STUDY OF THE MAXIMUM POWER THAT CAN BE OBTAINED FROM A WIND TURBINE IN A WIND SHEAR LAYER
Bo C. A. Johansson Apr. 1981 59 p refs
(FFA-134; ISSN-0081-5640) Avail: NTIS HC A04/MF A01; Aeronautical Research Inst. of Sweden, Stockholm Kr 70

Betz's stream tube theory for the maximum power that can be obtained from a wind turbine in a uniform flow is extended to two dimensions. The undisturbed velocity field (allowed to vary arbitrarily vertically) and the location of the wind turbine are given. The maximum power is calculated by calculus of variations. For common wind velocity profiles, the maximum power is only slightly larger than the power, which is obtained by a constant relative wind speed retardation equal to Betz's retardation, while for a linear velocity profile there is a considerable difference. Author (ESA)

N82-18720# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
MEASUREMENTS OF WAKE INTERACTION EFFECTS ON THE POWER OUTPUT FROM SMALL WIND TURBINE MODELS
Per-Henrik Alfredsson and Jan-Aake Dahlberg 4 Jul. 1981 62 p refs
(Contracts NE-5061-013; NE-5061-014)
(FFA-TN-HU-2189-Pt-5; ISSN-0081-5640) Avail: NTIS HC A04/MF A01

Power interference between two and three wind turbine models in a wind tunnel at four different ambient turbulence conditions was measured in order to assess turbine drag effects. Maximum power coefficient is 0.35 with a corresponding thrust coefficient of 0.85 at a tip speed ratio of 4. Flow visualization with small spacing between the turbines (2 x D) and power interaction measurements show that the presence of a downstream turbine affects the upstream turbine wake. By traversing a turbine across the wake of an upstream turbine, a chart of constant power lines (iso power lines) was established for the four ambient flow conditions. The power measurements in the wake can be used to estimate the overall efficiency of a limited array of wind turbines. Author (ESA)

N82-18721# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
ICING PROBLEMS FOR WIND TURBINES. SUMMARY OF STUDIES PERFORMED DURING WINTER SEASON 1980/81
Anders Gustafsson, Tord Kvick, and Staffan Meijer (Swedish Meteorological and Hydrological Inst.) 6 Oct. 1981 30 p refs Prepared in cooperation with Sydkraft AB
(Contract NE-5061-014)
(FFA-TN-HU-2262-Pt-4) Avail: NTIS HC A03/MF A01

The significance of an ice detector signal which shuts down a wind energy conversion system, not equipped with deicers, was studied. Correlations between the detector signal, meteorological parameters and ice buildup on the blades were investigated. Theoretical and field study data were used. Visual checks followed icing signals but little ice was observed since icing mostly occurred at night. The data are inadequate to enable conclusions to be drawn. Time lag between signals and visual observation must be shortened. Data must be collected when icing is expected, even if there is no signal. Author (ESA)

N82-19487 Iowa Univ., Oakdale.
RADIATIVE HEAT TRANSFER IN TURBULENT MHD CHANNEL FLOW Ph.D. Thesis
Fariborz Alipour-Haghighi 1981 148 p
Avail: Univ. Microfilms Order No. 8128371

Radiative heat transfer in a MHD channel has been studied for fully developed turbulent flow of an electrically conducting fluid. A uniform magnetic field is imposed transverse to the flow direction between the electrically insulated parallel plates. Thermal entry region is analyzed for constant wall temperature including viscous dissipation and Joulean heating. A van Dreist mixing length model with Mei and Squire correction factor is used for eddy diffusivity of momentum and a modified Cebeci model is used for eddy conductivity. An exponential wide band model is employed in evaluation of radiative heat flux for a real gas. The tegro-differential equation for thermal energy transport is solved by a finite difference iterative method. It is shown that radiative heat transer is a major mechanism of heat transfer in the channel and accelerates the thermal development and results in reduced gas temperature profiles. Dissert. Abstr.

N82-19550*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIENCE WITH MODIFIED AEROSPACE RELIABILITY AND QUALITY ASSURANCE METHOD FOR WIND TURBINES

William E. Klein 1982 11 p refs Proposed for Presentation at 9th Ann. Engr. Conf. on Reliability, Hershey, Penn., 16-18 Jun. 1982 Revised
(Contract DE-AI01-76ET-20320)
(NASA-TM-82803; DOE/NASA/20320-38; E-1142) Avail: NTIS HC A02/MF A01 CSCL 14D

The SR&QA approach assures that the machine is not hazardous to the public or operating personnel, can operate unattended on a utility grid, demonstrates reliability operation, and helps establish the quality assurance and maintainability requirements for future wind turbine projects. The approach consisted of modified failure modes and effects analysis (FMEA) during the design phase, minimal hardware inspection during parts fabrication, and three simple documents to control activities during machine construction and operation. Five years experience shows that this low cost approach works well enough that it should be considered by others for similar projects. T.M.

N82-19666 Department of Energy, London (England). Severn Barrage Committee.
TIDAL POWER FROM THE SEVERN ESTUARY, VOLUME 1
1981 125 p refs Original contains color illustrations 2 Vol.
(EP-46-Vol-1; ISBN-0-11-410916-8) Copyright. Avail: Issuing Activity; HMSO £9.80 + postage, PHI

Environmental, energy, and economic factors associated with building a tidal power barrage in the Bristol channel were studied. An ebb generation scheme is recommended since it minimizes the unit cost of electricity generation and has less effect on ports than flood or two way generation. The economic justification for a barrage depends on factors which are not known when the decision on whether to build is taken, e.g., the extent of nuclear generation, or the price of coal in the first third of the next century. Further study of the environmental consequences of the barrage is required. An inner barrage is recommended since the larger output of an outer barrage does not outweigh engineering, environmental and economic disadvantages. Author (ESA)

N82-19667 Department of Energy, London (England). Severn Barrage Committee.
TIDAL POWER FROM THE SEVERN ESTUARY. VOLUME 2: ANALYSIS, STUDIES, REPORTS AND EVALUATIONS
1981 470 p refs 2 Vol.
(EP-46-Vol-2; ISBN-0-11-410919-2) Copyright. Avail: Issuing Activity; HMSO £19.50 + postage, PHI

Environmental, energy, and economic factors associated with building a barrage in the Bristol channel were studied. Data collection and analysis are described. Sites, configurations, and costs are considered. Turbine caissons, sluice caissons, and hydroelectric plant are treated. Embankments, navigation and locks are discussed. Environmental, social, industrial, and economic impact are evaluated. An inner barrage, ebb generation scheme is recommended. Author (ESA)

N82-19670*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOSPHORIC ACID FUEL CELL TECHNOLOGY STATUS
Stephen N. Simons, Robert B. King, and Paul R. Prokopius 1981 20 p refs Presented at Fuel Cells: Technol. Status and Appl., Chicago 16-18 Nov. 1981; sponsored by Institute of Gas Technology
(Contract DE-AI01-80ET-17088)
(NASA-TM-82791; DOE/NASA/17088-3) Avail: NTIS HC A02/MF A01 CSCL 10A

A review of the current phosphoric acid fuel cell system technology development efforts is presented both for multimegawatt systems for electric utility applications and for multikilowatt systems for on-site integrated energy system applications. Improving fuel cell performance, reducing cost, and increasing durability are the technology drivers at this time. Electrodes, matrices, intercell cooling, bipolar/separator plates, electrolyte management, and fuel selection are discussed. B.W.

N82-19672*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE AND OPERATIONAL ECONOMICS ESTIMATES FOR A COAL GASIFICATION COMBINED-CYCLE COGENERATION POWERPLANT
Joseph J. Nainiger, Raymond K. Burns, and Annie J. Easley Mar. 1982 32 p refs
(NASA-TM-82729; E-1032) Avail: NTIS HC A03/MF A01 CSCL 10B

A performance and operational economics analysis is presented for an integrated-gasifier, combined-cycle (IGCC) system to meet the steam and baseload electrical requirements. The effect of time variations in steam and electrial requirements is included. The amount and timing of electricity purchases from sales to the electric utility are determined. The resulting expenses for purchased electricity and revenues from electricity sales are estimated by using an assumed utility rate structure model. Cogeneration results for a range of potential IGCC cogeneration system sizes are compared with the fuel consumption and costs of natural gas and electricity to meet requirements without cogeneration. The results indicate that an IGCC cogeneration system could save about 10 percent of the total fuel energy presently required to supply steam and electrical requirements without cogeneration. Also for the assumed future fuel and electricity prices, an annual operating cost savings of 21 percent to 26 percent could be achieved with such a cogeneration system. An analysis of the effects of electricity price, fuel price, and system availability indicates that the IGCC cogeneration system has a good potential for economical operation over a wide range in these assumptions. R.J.F.

N82-19681# Advanced Engineering Lab., Salisbury (Australia). Defence Research Centre.
FEASIBILITY STUDY ON A LOW POWER VERTICAL AXIS WIND-POWERED GENERATOR
W. R. Crook, T. Puust, M. L. Robinson, and L. J. Vencel Sep. 1980 102 p refs
(AEL-0039-TR; AR-001-672) Avail: NTIS HC A06/MF A01

Investigations carried out to establish a design concept for a 1 kW wind-powered generator suitable for use as an alternative power source in isolated locations is described. Design criteria include high power to weight ratio, simplicity of assembly, and potential for fixed, mobile or portable applications. A suitable configuration using a Darrieus straight blade rotor with a microprocessor based control system is proposed. Information on the power output to be expected in different wind environments is provided. Author

N82-19691# Friedrichsfeld G.m.b.H., Mannheim (West Germany). Steinzeug- und Kunststoffwerke.
PRODUCTION TECHNOLOGY OF AN OXYGEN ION CONDUCTIVE CERAMIC FOR HIGH TEMPERATURE FUEL CELLS AND HIGH TEMPERATURE WATER ELECTROLYSIS Final Report
Guenther Heimke, Helmut Mayer, and Arno Reckziegel Bonn Bundesministerium fuer Forschung und Technologie Oct. 1981 104 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-180; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 21.85

The cheap mass production of stabilized zirconia ceramic bodies with thin walls, suitable for high temperature fuel cell or water electrolysis applications is discussed. Chemical and thermal corrosion effects were laboratory tested. Such bodies sintered from YZ03-YbZ03 and YZ03 doped zirconia with high density, good electrical conductivity, small grain size, and 5 mm wall thickness can be produced by conventional methods at temperatures > 1700 C. Extremely fine grained structure ceramics of almost theoretical density can be produced at 1600 C using coprecipitated powders. These powders are, however, too expensive for mass production. Author (ESA)

N82-19695# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
A PITCH CONTROL SYSTEM FOR LARGE SCALE WIND TURBINES
Brad S. Liebst 12 Jan. 1981 146 p. refs Sponsored in cooperation with Aeronautical Research Foundation Prepared in cooperation with MIT
(Contract NE-5061-014)
(FFA-TN-HU-2262-Pt-6) Avail: NTIS HC A07/MF A01

A pitching blade segment control system, to alleviate problems associated with wind shear, tower shadow, and gravity, like shortened lifetime and noise generation was designed. The classical linear quadratic Gaussian optimal regulator approach is used in the control formulation. An aerodynamic analysis, incorporating wind shear and tower shadow, is performed. An equivalent hinge model describes the turbine structural dynamics.

Pitch, flap and lag blade degrees of freedom and shaft torsion and generator dynamics are included. It is shown that the system reduces vibration and noise, provides a cleaner power signal, improves gust response, and increases annual energy output.
Author (ESA)

N82-19792# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
TURBULENCE STATISTICS FOR DESIGN OF WIND TURBINE GENERATORS
J. C. Kaimal, J. E. Gaynor, and D. E. Wolfe Dec. 1980 109 p refs Sponsored in part by DOE
(PB82-112939; NOAA-81082702; Rept-3) Avail: NTIS HC A06/MF A01 CSCL 04B

Characteristics of moments and probability distributions for two high-wind episodes are examined in depth. The two episodes represent entirely different stability conditions. Statistics for the GUST 0 and GUST 1 models for different heights and bandpass filters are the main focus.
Author (GRA)

N82-20193# Sandia Labs., Albuquerque, N. Mex. Dept. of Engineering Science and Mechanics.
METHODS FOR ANALYSIS OF WIND RIPPLE IN WIND TURBINES
R. E. Akins Apr. 1981 59 p refs
(Contract DE-AC04-76-DP-00789)
(SAND-81-7006) Avail: NTIS HC A04/MF A01

Efficient and economical utilization of wind power requires the ability to measure and ultimately predict the effects fluctuations in the incident wind have on a wind turbine. In order to begin to quantitatively assess these effects, experimental techniques were developed to allow analysis of full-scale performance of wind turbines with particular emphasis on the effects caused by turbulence in the incident wind.
R.J.F.

N82-20402*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE 1981 GODDARD SPACE FLIGHT CENTER BATTERY WORKSHOP
Gerald Halpert, ed Mar. 1982 544 p Workshop held in Greenbelt, Md., 17-19 Nov. 1981
(NASA-CP-2217; NAS 1.55:2217) Avail: NTIS HC A23/MF A01 CSCL 10C

Results of testing, analysis, and development of lithium, nickel-cadmium, and nickel-hydrogen batteries are reported. Focus is on the improvement of power systems in the areas of high capacity, high energy density, and long cycle and storage life. Applications of these batteries as spacecraft power supplies are discussed. Those spacecraft include deepspace probes, spacecraft in geostationary orbit, and large space systems in low-Earth orbit. For individual titles, see N82-20403 through N82-20446.

N82-20644*# Hydrothermal Power Co. Ltd., Mission Viejo, Calif.
DESIGN, FABRICATION, DELIVERY, OPERATION AND MAINTENANCE OF A GEOTHERMAL POWER CONVERSION SYSTEM Final Report
Dec. 1980 139 p refs Prepared for JPL
(Contract JPL-954404)
(NASA-CR-168653; NAS 1.26:168653) Avail: NTIS HC A07/MF A01 CSCL 10B

The design, fabrication, delivery, operation and maintenance of an Hydrothermal Power Company 1250 KVA geothermal power conversion system using a helical screw expander as the prime mover is described. Hydrostatic and acceptance testing are discussed.
R.J.F.

N82-20667*# FWG Associates, Inc., Tullahoma, Tenn.
THEORETICAL DESIGN STUDY OF THE MSFC WIND-WHEEL TURBINE Final Report
Walter Frost and Philip A. Kessel Mar. 1982 44 p refs
(Contract NAS8-34387)
(NASA-CR-3532; NAS 1.26:3532) Avail: NTIS HC A03/MF A01 CSCL 10A

A wind wheel turbine (WWT) is studied. Evaluation of the probable performance, possible practical applications, and economic viability as compared to other conventional wind energy systems is discussed. The WWT apparatus is essentially a bladed wheel which is directly exposed to the wind on the upper half and exposed to wind through multiple ducting on the lower half. The multiple ducts consist of a forward duct (front concentrator) and two side ducts (side concentrators). The forced rotation of the wheel is then converted to power through appropriate subsystems. Test results on two simple models, a paper model and a stainless steel model, are reported. Measured values of power coefficients over wind speeds ranging from 4 to 16 m/s are given. An analytical model of a four bladed wheel is also developed. Overall design features of the wind turbine are evaluated and discussed. Turbine sizing is specified for a 5 and 25 kW machine. Suggested improvements to the original design to increase performance and performance predictions for an improved WWT design are given.
S.L.

N82-20678# Hydrologic Engineering Center, Davis, Calif.
POTENTIAL FOR INCREASING THE OUTPUT OF EXISTING HYDROELECTRIC PLANTS
Darryl W. Davis and John J. Buckley Jun. 1981 26 p refs Presented at the Waterpower 81st Intern. Conf. on Hydropower, Washington, D.C., 22-24 Jun. 1981
(AD-A109772; HEC-TP-78) Avail: NTIS HC A03/MF A01 CSCL 10/2

The potential for increasing power output both through physical improvements in generating equipment and by changes in the manner that existing projects are operated were investigated and estimates of power increase prepared. The investigation was nationwide in scope, including Hawaii, Alaska, and Puerto Rico. All existing hydroelectric plants, regardless of ownership, were investigated for improvement in power output. The potential is identified by the type of improvement and is reported as aggregate regional values and national summaries.
GRA

N82-20685# California Univ., Livermore. Lawrence Livermore Lab.
ASSESSMENT OF THE SUITABILITY OF AGRICULTURAL WASTE WATER FOR GEOTHERMAL POWER PLANT COOLING IN THE IMPERIAL VALLEY. 1: WATER QUALITY
W. F. Morris Sep. 1981 36 p refs
(Contract W-7405-eng-48)
(DE82-001869; UCID-19205) Avail: NTIS HC A03/MF A01

Evaluation of the quality of agricultural waste water is the first step in assessing the suitability of agricultural waste water for geothermal power plant cooling. Samples of agricultural waste water from the New and Alamo rivers located in the Imperial Valley of California were analyzed. Determinations of standard water quality parameters, solids content, and inorganic compositions of the solids were made. The results are compared with data on samples of irrigation water and steam condensate also obtained from sites in the Imperial Valley. The data were evaluated in relation to cooling tower operation, waste generation, and waste disposal.
DOE

N82-20688# Midwest Research Inst., Golden, Colo.
ELECTRIC UTILITY VALUE ANALYSIS METHODOLOGY FOR WIND ENERGY CONVERSION SYSTEMS
L. R. Bush, C. Keith Cretcher, and Ted H. Davey Sep. 1981 31 p refs
(Contract DE-AC02-77CH-00178)
(DE82-003573; SERI/TR-98336-1) Avail: NTIS HC A03/MF A01

The methodology summarized in this report was developed in support of a study of the value of augmenting conventional electric energy generation with wind energy conversion systems (WECS). A major objective of the value analysis study is the creation of an analytical methodology to assess WECS installed in a utility's generation system. The pertinent measures of value include both the displacement of conventional fuels measured in volumetric and economic terms, and the potential for capacity credit, realized either through the sale of capacity of deferral of new installations. Recognizing the strong site dependence of wind energy conversion, a second major objective of the value analysis study is the application of the methodology to several candidate utilities. These results will illustrate the practicability of the methodology and identify any deficiencies, allow a comparison of relative WECS value among the sites studied, and develop background information pertinent to possible selection decisions for WECS siting and level of penetration. The specific purpose of this report is to outline the methodology developed in support of the value analysis study.
DOE

N82-21030*# Bionetics Corp., Hampton, Va.
SOUND MEASUREMENTS AND OBSERVATIONS OF THE MOD-0A WIND TURBINE GENERATOR
Kevin P. Shepherd and Harvey H. Hubbard (College of William and Mary, Newport News, Va.) Feb. 1982 20 p refs

(Contract NAS1-14970; Grant NAG1-166)
(NASA-CR-165856; NAS 1.26:165856) Avail: NTIS HC A02/MF A01 CSCL 20A

Sound measurements are reported for a wind velocity of about 5 m/s and a power output of about 70 kW. Both broadband and narrowband data were obtained for a range of distances and azimuth angles from the machine. Both discrete frequency and broadband components were identified. Loading harmonics at multiples of the blade passage frequency and electrical generator harmonics at multiples of the shaft speed dominated the spectrum below 100 Hz. The 10,000 Hz peak is believed to be of mechanical origin in the nacelle and the other arises from blade aerodynamic sources. Aural detection distances of about 525 m upwind and 850 downwind were observed. T.M.

N82-21063 British Library Lending Div., Boston Spa (England).
FORECASTING THE TECHNICAL AND ECONOMIC CHARACTERISTICS OF HIGH POWER THERMONUCLEAR TOKAMAK REACTORS
A. N. Karkhov and B. P. Maksimenko 24 Jun. 1981 22 p refs Transl. into ENGLISH from Atomnaya Tikh. za Rubeshom (USSR), no. 3, 1980 p 19-28
(BLL-CTO-1921-(9091.9F)) Avail: British Library Lending Div., Boston Spa, Engl.

Methods for making parametric investigations of Tokamak power reactors by predicting their technical and economic parameters to determine the direction in which the concept will develop are examined. High temperature plasma physics, the engineering and technical development of Tokamak reactor concepts, mathematical models of individual systems and subsystems, and computational programs developed for the parametric investigations are examined. R.J.F.

N82-21193*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR PERFORMANCE OF A 15.41-cm-TIP-DIAMETER AXIAL-FLOW POWER TURBINE WITH VARIABLE-AREA STATOR DESIGNED FOR A 75-kW AUTOMOTIVE GAS TURBINE ENGINE Final Report
Kerry L. McLallin, Milton G. Kofskey, and Robert Y. Wong Feb. 1982 33 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-82644; E-899; NAS 1.15:82644; DOE/NASA/51040-30) Avail: NTIS HC A03/MF A01 CSCL 21E

An experimental evaluation of the aerodynamic performance of the axial flow, variable area stator power turbine stage for the Department of Energy upgraded automotive gas turbine engine was conducted in cold air. The interstage transition duct, the variable area stator, the rotor, and the exit diffuser were included in the evaluation of the turbine stage. The measured total blading efficiency was 0.096 less than the design value of 0.85. Large radial gradients in flow conditions were found at the exit of the interstage duct that adversely affected power turbine performance. Although power turbine efficiency was less than design, the turbine operating line corresponding to the steady state road load power curve was within 0.02 of the maximum available stage efficiency at any given speed. Author

N82-21194*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY RESULTS ON PERFORMANCE TESTING OF A TURBOCHARGED ROTARY COMBUSTION ENGINE
P. R. Meng, W. J. Rice, H. J. Schock, and D. P. Pringle 1982 24 p refs Presented at the 1982 Soc. of Automotive Engrs. Intern. Congr. and Exposition, Detroit, 22-26 Feb. 1982
(NASA-TM-82772; E-1097; NAS 1.15:82772) Avail: NTIS HC A02/MF A01 CSCL 21E

The performance of a turbocharged rotary engine at power levels above 75 kW (100 hp) was studied. A twin rotor turbocharged Mazda engine was tested at speeds of 3000 to 6000 rpm and boost pressures to 7 psi. The NASA developed combustion diagnostic instrumentation was used to quantify indicated and pumping mean effect pressures, peak pressure, and face to face variability on a cycle by cycle basis. Results of this testing showed that a 5900 rpm a 36 percent increase in power was obtained by operating the engine in the turbocharged configuration. When operating with lean carburetor jets at 105 hp (78.3 kW) and 4000 rpm, a brake specific fuel consumption of 0.45 lbm/lb-hr was measured. B.W.

N82-21196*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
ENERGY EFFICIENT ENGINE SHROUDLESS, HOLLOW FAN BLADE TECHNOLOGY REPORT
C. J. Michael Dec. 1981 91 p refs
(Contract NAS3-20646)
(NASA-CR-165586; NAS 1.26:165586; PWA-5594-199) Avail: NTIS HC A05/MF A01 CSCL 21E

The Shroudless, Hollow Fan Blade Technology program was structured to support the design, fabrication, and subsequent evaluation of advanced hollow and shroudless blades for the Energy Efficient Engine fan component. Rockwell International was initially selected to produce hollow airfoil specimens employing the superplastic forming/diffusion bonding (SPF/DB) fabrication technique. Rockwell demonstrated that a titanium hollow structure could be fabricated utilizing SPF/DB manufacturing methods. However, some problems such as sharp internal cavity radii and unsatisfactory secondary bonding of the edge and root details prevented production of the required quantity of fatigue test specimens. Subsequently, TRW was selected to (1) produce hollow airfoil test specimens utilizing a laminate-core/hot isostatic press/diffusion bond approach, and (2) manufacture full-size hollow prototype fan blades utilizing the technology that evolved from the specimen fabrication effort. TRW established elements of blade design and defined laminate-core/hot isostatic press/diffusion bonding fabrication techniques to produce test specimens. This fabrication technology was utilized to produce full size hollow fan blades in which the HIP'ed parts were cambered/twisted/isothermally forged, finish machined, and delivered to Pratt & Whitney Aircraft and NASA for further evaluation. Author

N82-21710*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MICROPROCESSOR CONTROL SYSTEM FOR 200-KILOWATT MOD-0A WIND TURBINES Final Report
Ted W. Nyland and Arthur G. Birchenough Jan. 1982 26 p refs
(Contract DE-AI01-76ET-20370)
(NASA-TM-82711; E-10006; NAS 1.15:82711; DOE/NASA/20370-22) Avail: NTIS HC A03/MF A01 CSCL 10A

The microprocessor system and program used to control the operation of the 200-kW Mod-0A wind turbines is described. The system is programmed to begin startup and shutdown sequences automatically and to control yaw motion. Rotor speed and power output are controlled with integral and proportional control of the blade pitch angle. Included in the report are a description of the hardware and a discussion of the software programming technique. A listing of the PL/M software program is given. Author

N82-21712*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF THE REGENERATOR FOR THE CHRYSLER UPGRADED AUTOMOTIVE GAS TURBINE ENGINE Final Report
Jerry M. Winter and Ralph C. Nussle Feb. 1982 62 p refs
(Contract DE-AI01-77CS-51040)
(NASA-TM-82671; E-953; DOE/NASA/51040-32; NAS 1.15:82671) Avail: NTIS HC A04/MF A01 CSCL 10B

Automobile gas turbine engine regenerator performance was studied in a regenerator test facility that provided a satisfactory simulation of the actual engine operating environment but with independent control of airflow and gas flow. Velocity and temperature distributions were measured immediately downstream of both the core high-pressure-side outlet and the core low-pressure-side outlet. For the original engine housing, the regenerator temperature effectiveness was 1 to 2 percent higher than the design value, and the heat transfer effectiveness was 2 to 4 percent lower than the design value over the range of test conditions simulating 50 to 100 percent of gas generator speed. Recalculating the design values to account for seal leakage decreased the design heat transfer effectiveness to values consistent with those measured herein. A baffle installed in the engine housing high-pressure-side inlet provided more uniform velocities out of the regenerator but did not improve the effectiveness. A housing designed to provide more uniform axial flow to the regenerator was also tested. Although temperature uniformity was improved, the effectiveness values were not improved. Neither did 50-percent flow blockage (90 degree segment) applied to the high-pressure-side inlet change the effectiveness significantly. Author

N82-21713*# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.

CELL MODULE AND FUEL CONDITIONER DEVELOPMENT Quarterly Report, Oct. - Dec. 1981

J. M. Feret Jan. 1982 51 p

(Contract DEN3-161; Contract DE-AI01-80ET-17088)

(NASA-CR-165620; DOE/NASA/0161-9A; NAS 1.26:165620; QR-9) Avail: NTIS HC A04/MF A01 CSCL 10A

The efforts performed to develop a phosphoric acid fuel cell (PAFC) stack design having a 10 kW power rating for operation at higher than atmospheric pressure based on the existing Mark II design configuration are described. The work involves: (1) Performance of pertinent functional analysis, trade studies and thermodynamic cycle analysis for requirements definition and system operating parameter selection purposes, (2) characterization of fuel cell materials and components, and performance testing and evaluation of the repeating electrode components, (3) establishment of the state-of-the-art manufacturing technology for all fuel cell components at Westinghouse and the fabrication of short stacks of various sites, and (4) development of a 10 kW PAFC stack design for higher pressure operation utilizing the top down systems engineering approach. . Author

N82-21719# Naval Civil Engineering Lab., Port Hueneme, Calif.

WIND POWER UTILIZATION GUIDE Progress Report, Jul. 1975 - Sep. 1980

D. Pal Sep. 1981 218 p refs

(AD-A110337; CEL-TN-1613) Avail: NTIS HC A10/MF A01 CSCL 04/2

This report presents general information covering site wind potential and characteristics, specific design, system design, and siting requirements for utilization of wind energy conversion systems (WECS) at Navy installations. The objective of this report is also to provide a method for performing economic analysis to plan and justify a WECS in a particular Navy application. The information presented here is sufficient to enable an engineer to prepare a system's design to conduct a feasibility study for a given application of WECS. Most Navy applications of wind power will involve generation of electricity using small wind turbine generators (less than 60 kW size), with or without storage, located at remote Navy sites. Larger (over 100 kW size) WECS will, generally, be integrated with a base grid located on remote overseas or CONUS bases. This report, however, deals only with guidance for applying small WECS at Navy installations. The subject matter is divided into five parts dealing respectively with wind behavior and its determination with wind-driven turbines, power conditioning requirements, siting requirements, and the economics of wind power under different conditions. Three examples are given to demonstrate use of these sections in developing the required feasibility or design information for a given application. Author (GRA)

N82-21722# Argonne National Lab., Ill. Chemical Engineering Div.

ADVANCED FUEL-CELL DEVELOPMENT Progress Report, Jul. - Sep. 1980

R. D. Pierce, R. M. Arons, J. T. Dusek, A. V. Fraioli, G. H. Kucera, R. B. Poeppel, J. W. Sim, J. L. Smith, and R. S. Tani Jul. 1981 37 p refs

(Contract W-31-109-eng-38)

(DE82-003007; ANL-81-16) Avail: NTIS HC A03/MF A01

Efforts were directed toward: investigating alternative concepts for components of molten carbonate fuel cell stacks; and improving out understanding of component behavior. The principal focus is on the development of sintered beta-LiAlO2 for electrolyte support and sintered Li sub x Ni sub 1-x O for cathodes. In the electrolyte development effort, both alpha- and beta-LiAlO2 were synthesized as starting material for sintered electrolyte supports, and tape casting was studied for preparing green bodies for intering. A sintering procedure was developed which produces flat NiO cathodes with good conductivity and pore structure. T.M.

N82-21723# Westinghouse Electric Corp., Pittsburgh, Pa.

EVALUATION OF GASIFICATION AND GAS-CLEANUP PROCESSES FOR USE IN MOLTEN-CARBONATE FUEL-CELL POWER PLANTS Quarterly Technical Progress Report

Gary Jablonski (Davy-McKee), M. A. Alvin, R. A. Wenglarz, and P. Patel 16 Jul. 1981 24 p refs

(Contract DE-AC21-81MC-16220)

(DE82-003207; DOE/MC-16220/T1; QTPR-1) Avail: NTIS HC A02/MF A01

A draft of the gasifier listing, a low temperature gas cleanup system listing and data acquisition for the hot gas cleaning systems listing were completed. Iron oxide, dolomite, zinc oxide, molten carbonate and other such systems were included in that listing. The molten carbonate fuel cell (MCFC) contaminant data available in the open literature are reported. Particulate and chemical species for assessing the effect of contaminants on MCFC operating characteristics are thermodynamically evaluated. Data and process insights, indispensable to the evaluation of suitable coal gas supply systems for molten carbonate fuel cell power plants are provided. DOE

N82-21732# United Technologies Corp., South Windsor, Conn. Power Systems Div.

DEVELOPMENT OF MOLTEN-CARBONATE FUEL-CELL POWER-PLANT TECHNOLOGY Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1980

Feb. 1981 65 p

(Contracts DE-AC02-79ET-15440; DE-AC01-79ET-15440)

(DE82-002108; DOE/ET-15440/4; QTPR-4; FCR-2765) Avail: NTIS HC A04/MF A01

The design of a prototype molten carbonate fuel cell stack which meets the requirements of 1990's competitive coal fired electrical utility central station or industrial cogeneration power plants was developed. The four task areas are: (1) systems studies to define the reference power plant design; (2) cell and stack design, development and verification; (3) preparation for fabrication and testing of the full scale prototype stack; and, (4) development of the capability to operate stacks on coal derived gas. DOE

N82-21756*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

GEOTHERMAL PROBABILISTIC COST STUDY

L. H. Orren, G. Michael Ziman, Sue Campbell Jones, Tom K. Lee (California Univ., San Diego), Roger Noll (California Univ., San Diego), Louis Wilde (California Inst. of Tech., Pasadena), and Venkatraman Sadanand (California Inst. of Tech., Pasadena) Aug. 1981 196 p refs Sponsored in part by NASA

(Contract DE-AI03-79ET-37116)

(NASA-CR-168757; NAS 1.26:168757; DE82-003230; DOE/ET-37116/T4) Avail: NTIS HC A09/MF A01 CSCL 10B

A tool is presented to quantify the risks of geothermal projects, the Geothermal Probabilistic Cost Model (GPCM). The GPCM model was used to evaluate a geothermal reservoir for a binary-cycle electric plant at Heber, California. Three institutional aspects of the geothermal risk which can shift the risk among different agents was analyzed. The leasing of geothermal land, contracting between the producer and the user of the geothermal heat, and insurance against faulty performance were examined. DOE

N82-21759# San Diego Gas and Electric Co., Calif.

HEBER GEOTHERMAL BINARY DEMONSTRATION PROJECT Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1981

G. D. VanDeMark Sep. 1981 32 p Sponsored in part by Electric Power Research Inst., Imperial Irrigation District, Calif. Dept. of Water Resources, and Southern Calif. Edison Co.

(Contract DE-FC03-80RA-50239)

(DE82-002462; DOE/RA-50239/T1) Avail: NTIS HC A03/MF A01

Work completed on the nominal 65 Megawatt (Mwe gross) Heber geothermal binary demonstration project, located at Heber, California, is documented. Topics covered include progress made in the areas of wells, fluid production and injection systems, power plant design and construction, power plant demonstration, and data acquisition and dissemination. DOE

06
ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission.

A82-20640 * **Microwave power - An energy transmission alternative for the year 2000.** E. Nalos and R. Sperber (Boeing Aerospace Co., Kent, WA). In: NTC '80; National Telecommunications Conference, Houston, TX, November 30-December 4, 1980, Conference Record. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 48.1.1-48.1.5. 9 refs. Research supported by the U.S. Department of Energy; Contract No. NAS9-15636.

Recent technological advances related to the feasibility of efficient RF-dc rectification make it likely that by the year 2000 the transmission of power through space will have become a practical reality. Proposals have been made to power helicopters, aircraft, balloons, and rockets remotely. Other proposals consider the transfer of power from point to point on earth via relay through space or a transmission of power from large power sources in space. Attention has also been given to possibilities regarding the transmission of power between various points in the solar system. An outline is provided of the microwave power transmission system envisaged for the solar power satellite, taking into account the transmitting antenna, the receiver on earth, aspects of beam formation and control, transmitter options, the receiving antenna design, and cost and efficiency considerations. G.R.

A82-21975 **Equilibrium two-phase heat pipe flows with variable flowrate.** L. A. Vulis, I. G. Goriachko, and G. V. Zhizhin. (Krizisy teploobmena i okolokriticheskaia oblast', p. 112-117.) *Heat Transfer - Soviet Research*, vol. 12, Nov.-Dec. 1980, p. 120-126. Translation.

The problem of steady pipe flow of vapor in thermodynamic equilibrium with liquid droplets is analyzed as a part of a study of possible operating modes in a heat pipe. The analysis accounts for phase transitions within the flow core, with phase properties (e.g., velocity and temperature) averaged over the channel cross section. It is assumed that the supplied (or removed) heat is expended completely on phase transitions at the channel walls and that the mean phase velocities are equal, i.e., there is no slip. A set of equations are obtained which allow the calculation of flow parameters in any channel section. V.L.

A82-23944 **High power pulsed oscillators.** F. A. Myers (Plessey Research /Caswell/, Ltd., Allen Clark Research Centre, Towcester, Northants., England). In: Microwave solid state devices and applications. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1980, p. 187-195. 9 refs.

Available pulsed sources are briefly reviewed including the TRAPATT device, the high-efficiency IMPATT, the Si avalanche device, the Si bipolar transistor, and the Gunn device. Pulsed Gunn oscillators are then discussed with reference to their operational parameters, advantages, and problems encountered. Design guidelines for a Gunn oscillator are presented. V.L.

N82-17448# Westinghouse Research and Development Center, Pittsburgh, Pa.
MATERIALS RESEARCH FOR HYDROGEN-COOLED SUPERCONDUCTING POWER TRANSMISSION LINES
Quarterly Report, 1 Apr. - 30 Jun. 1981
A. M. Sietten, A. I. Braginski, M. Rosado, J. R. Gavaler, J. Greggi, J. Schreurs, R. H. Hammond, J. R. Kwo, M. Perez, J. Talvacchio et al. 1981 42 p refs Prepared in cooperation with Stanford Univ., Calif.
(Contract DE-AC02-89ET-29354)
(DE82-002171: DOE/ET-29354/T1: QR-7) Avail: NTIS HC A03/MF A01

Dielectric breakdown and loss measurements in liquid hydrogen and liquid hydrogen impregnated synthetic dielectrics are investigated at temperatures between 14 and 200K and at hydrostatic pressures up to five atmospheres. The effects of dissolved impurities/additives in the liquid are determined, and the self field and low field superconducting properties of high critical temperature materials at temperatures between approximately 14 and 200K are characterized. The construction of the dielectric test apparatus continued and the system of small electrodes was completed. Difficulties were encountered in the construction of the LH2 vessels and the junction box, which have retarded their completion. DOE

N82-18075# New England River Basins Commission, Boston, Mass.
PROCEDURES FOR PREPARING REGIONAL TRANSPORTATION MANAGEMENT PLANS
Michael J. Goetz Aug. 1981 177 p refs
(Contract DI-AA851-IOA-51)
(PB82-106162) Avail: NTIS HC A09/MF A01 CSCL 13B

A set of procedures is presented to provide planners with a working framework for preparing regional transportation management plans. These plans are designed to insure the safe and timely transportation of oil and gas produced offshore to onshore processing and distribution systems. A case study application to the Georges Bank region of the North Atlantic outer continental shelf is included. GRA

N82-18578*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPACE LASER POWER TRANSMISSION SYSTEM STUDIES
M. D. Williams, ed. and E. J. Conway, ed. Feb. 1982 210 p refs Symp. held in Hampton, Va., 14-15 Oct. 1981
(NASA-CP-2214; L-15030) Avail: NTIS HC A10/MF A01 CSCL 20E

Power transmission by laser technique is addressed. Space to Earth and space to space configurations are considered. For individual titles, see N82-18579 through N82-18586.

N82-18579*# Ball Aerospace Systems Div., Boulder, Colo.
PRELIMINARY STUDY ON THE USE OF LASERS FOR THE TRANSMISSION OF POWER
In NASA Langley Research Center Space Laser Power Transmission System Studies Feb. 1982 p 15-32

Avail: NTIS HC A10/MF A01 CSCL 20E

The use of lasers in space is outlined. Possibilities and ideas are presented. The economic payoff of lasers in space in supplying energy for the Earth is considered. Possible operational advantages and economies for the user of space to space energy transmission are addressed. The development of large space power stations to beam energy to Earth is discussed. Applications on Earth and comparisons with microwave systems are emphasized. N.W.

N82-18580*# Schafer (W. J.) Associates, Inc., Arlington, Va.
A STUDY TO SURVEY NASA LASER APPLICATIONS AND IDENTIFY SUITABLE LASERS FOR SPECIFIC NASA NEEDS
In NASA Langley Research Center Space Laser Transmission System Studies Feb. 1982 p 33-44 refs

Avail: NTIS HC A10/MF A01 CSCL 20E

All potential applications of high power lasers which might, in particular, use the JPL copper-halide laser under development were considered for study. A wide range of applications were identified with strong emphasis on remote sensing applications. Power beaming and laser propulsion were also identified as major areas of interest to NASA. N.W.

N82-18583*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
UTILITY AND TECHNOLOGY FOR A SPACE CENTRAL POWER STATION
Paul F. Holloway and L. Bernard Garrett *In its* Space Laser Power Transmission System Studies Feb. 1982 p 85-122 refs Presented at the Second AIAA Conf. on Large Space Platforms, Feb. 1981

Avail: NTIS HC A10/MF A01 CSCL 20E

The technological and economical impacts of a large central power station in Earth orbit on the performance and cost of future spacecraft and their orbital-transfer systems are examined.

It is shown that beaming power to remote users cannot be cost-effective if the central power station uses the same power generation system that would be readily available for provision of on-board power. Laser transmitters/receivers to make central power stations feasible are considered. The cost-effectiveness of meeting Earth-orbiting spacecraft electrical demands from a central power station was analyzed, indicating that this application cannot justify the investment required for the central station. Key technology needs which must be met to enable a viable central power station in the future are identified. N.W.

N82-18585*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

LASER POWER CONVERSION SYSTEM ANALYSIS

In NASA. Langley Research Center Space Laser Power Transmission System Studies Feb. 1982 p 145-158 refs

Avail: NTIS HC A10/MF A01 CSCL 20E

Orbit to orbit and orbit to ground laser power conversion systems and power transfer are discussed. A system overview is presented. Pilot program parameters are considered: SLPS assumptions are listed, a laser SPS overview is presented, specifications are listed, and SLPS costs are considered. N.W.

N82-18586*# Mathematical Sciences Northwest, Inc., Bellevue, Wash.

SPACE LASER POWER TRANSMISSION

In NASA. Langley Research Center Space Laser Power Transmission System Studies Feb. 1982 p 165-174 refs

Avail: NTIS HC A10/MF A01 CSCL 20E

Proposed laser transmission applications are reviewed. Technologies for laser power transmissions are assessed. Feasible laser mission systems are set out. Components by wavelength are summarized. Feasible space to space laser power transmission systems are summarized. Space laser transmitter masses for 1 MW and 100 KW output power are summarized. N.W.

N82-18710# Technische Hochschule, Aachen (West Germany). Lehrauftrag Leistungsreaktoren.

RAILWAY TRANSPORT OF LOW TEMPERATURE HEAT FROM LARGE POWER STATIONS BY MEANS OF ALTERNATIVE HEAT CARRIERS AND WATER Final Report

Gerardus Luchtman and Theo Bracke Bonn Bundesministerium fuer Forschung und Technology Nov. 1981 165 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technology

(BMFT-FB-T-81-145; ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 32.60

The feasibility of railway transport of liquid and solid heat carriers in tank cars so as to replace pipeline transport of small to medium large heat loads was investigated. The typical characteristics of railway transport were analyzed and all essential technical and economical variables were integrated in a transport model. Over 1000 complex chemical compounds were evaluated for their suitability as heat carriers. Of these, three ammonia compounds are considered as promising. Considering, however, that complicated and expensive facilities are needed for heat transfer to and from ammonia, water is identified as the better choice. Results, based on 1975 transport prices, show that railway heat transport becomes competitive for heat loads above 50 to 100 MW and transport distances over 20 km Author (ESA)

N82-18723# Institute for Telecommunication Sciences, Boulder, Colo.

ELECTROMAGNETIC COMPATIBILITY ANALYSIS FOR A SATELLITE POWER SYSTEM RECEIVING SITE IN THE MOJAVE DESERT

E. L. Morrison, W. B. Grant, and E. J. Lutton Jun. 1981 86 p refs Sponsored in part by DOE

(PB82-100710; NTIA/Rept-81-76) Avail: NTIS HC A05/MF A01 CSCL 10B

The Satellite Power System (SPS) as a source of baseline electrical power was evaluated. The SPS program develops an initial understanding of the technical feasibility, the economic practicality, and the social and environmental acceptability of the SPS concept. Electromagnetic compatibility (EMC) of an SPS with existing and planned electromagnetic and electronic systems is illustrated. A methodology is developed for rectenna site EMC analysis and impact evaluation. GRA

07
ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

A82-19116 **Storing wind energy as a liquid fuel.** D. Miller (Haverford College, Haverford, PA). In: Wind Energy Workshop, 2nd, Cranfield, Beds., England, April 1980, Proceedings. London, Multi-Science Publishing Co., Ltd., 1980, p. 143-150. 12 refs.

A system which stores wind energy has been designed. Formic acid is synthesized in an electrolytic reactor using inexpensive catalysts. The vertical axis wind turbine has high solidity and fixed, straight blades. Its low aspect ratio contributes to a power coefficient of 0.43. Power is transmitted hydraulically, and the generator is a modified Faraday disk. The turbine operates at maximum power over the full range of wind speeds, because the area of the reactor electrodes is varied. Costs for equipment are presented, as well as a strategy for using wind energy stored as a liquid fuel. (Author)

A82-20749 * # **Synthetic battery cycling.** L. H. Thaller (NASA, Lewis Research Center, Cleveland, OH). *Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, Aug. 9-14, 1981, Paper.* 11 p.

The trend in energy storage is toward systems with high-voltage and high-power outputs. These conditions accentuate the cumulative effects of small differences in characteristics from cell to cell in any large multicell battery. These considerations are of particular concern with a number of emerging electrochemical concepts where convenient overcharge reactions do not exist. The use of interactive computer graphics is suggested as an aid in battery system development. Mathematical representations of simplistic but fully representative functions of many electrochemical concepts of current practical interest will permit battery-level charge and discharge phenomena to be analyzed in a qualitative manner prior to the assembly and testing of actual hardware. This technique will be a useful addition to the variety of tools available to the battery system designer as he bridges the gap between interesting single-cell life test data and reliable energy storage subsystems. (Author)

A82-23206 **Energy storage: A vital element in mankind's quest for survival and progress.** Edited by J. Silverman (Maryland, University, College Park, MD). Oxford, Pergamon Press, 1980. 595 p. $100.

Among the topics on the development status of energy storage technologies covered are (1) metal-air batteries, electric vehicle electrochemical energy storage, fuel cells and lithium/metal sulfide batteries; (2) aquifer thermal energy storage, metal hydride thermal energy storage, and thermochemical hydrogen production; (3) artificial photochemical solar energy storage, semiconductor-liquid junction solar cells, and photoredox processes; and (4) compressed air and flywheel mechanical energy storage. Consideration is also given to the modelling and assessment of the energy storage alternatives covered, in automotive and electric utility contexts. O.C.

A82-23777 **Thermodynamic studies of Li-Ge alloys - Application to negative electrodes for molten salt batteries.** M. R. Saint John, A. J. Furgala, and A. F. Sammells (Institute of Gas Technology, Chicago, IL). *Electrochemical Society, Journal*, vol. 129, Feb. 1982, p. 246-250. 33 refs.

A82-23778 * **Inexpensive cross-linked polymeric separators made from water-soluble polymers.** L.-C. Hsu and D. W. Sheibley (NASA, Lewis Research Center, Cleveland, OH). *Electrochemical Society, Journal*, vol. 129, Feb. 1982, p. 251-254.

Polyvinyl alcohol (PVA), cross-linked chemically with aldehyde reagents, produces membranes which demonstrate oxidation resistance, dimensional stability, low ionic resistivity (less than 0.8 Ohms sq cm), low zincate diffusivity (less than 1 x 10 to the -7th mols/sq cm per min), and low zinc dendrite penetration rate (greater than 350 min) which make them suitable for use as alkaline battery separators. They are intrinsically low in cost, and environmental health and safety problems associated with commercial production appear minimal. Preparation, property measurements, and cell test results in Ni/Zn and Ag/Zn cells are described and discussed. (Author)

A82-24236 **Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980.** Symposium sponsored by the Joint Services Electrical Power Sources Committee. Edited by J. Thompson (Royal Aircraft Establishment, Farnborough, Hants., England). London, Academic Press, 1981. 641 p. $128.

Topics discussed include improved lithium thionyl chloride cells using a new electrolyte, the reaction products of Li-SOCl2 cells, and glass-to-metal seal corrosion in lithium-sulfur dioxide cells. Papers are presented on the characteristics and applications of Li-MnO2 cells, on developments in solid state batteries, on the use of crown ethers in electrochemical cells, and on molten carbonate fuel cell improvements. Attention is also given to redox storage systems for solar applications, to the thermal management of batteries, to a review of recent developments in thermal batteries, and to the characteristics of large calcium-thionyl chloride cells. C.R.

A82-24240 * **Redox storage systems for solar applications.** N. H. Hagedorn and L. H. Thaller (NASA, Lewis Research Center, Cleveland, OH). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 227-242; Discussion, p. 242, 243. 5 refs.

It is noted that the worldwide development of solar photovoltaic and wind turbine systems to meet a range of terrestrial electrical energy requirements has underscored the need for inexpensive and reliable electrical energy storage. The NASA Redox Energy Storage System, based on soluble aqueous iron and chromium chloride redox couples, has exhibited many system-related features which for the most part are unique to this storage system. The technology advances required in the two elements (electrodes and membranes), which are the key to its technological feasibility, have been attained and system development has begun. The design, construction, and testing of a 1-kW system integrated with a solar photovoltaic array is underway to provide early demonstration of the attractive system-related features of the NASA Redox Storage System. Also demonstrated will be its versatility and compatibility with a terrestrial solar photovoltaic electric power system. C.R.

A82-24241 **Thermal management of batteries.** H. F. Gibbard and C.-C. Chen (Gould Laboratories, Rolling Meadows, IL). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 263-284. 15 refs. U.S. Department of Energy Contracts No. 31-109-38-4200; No. 31-109-38-5006.

Control of the internal temperature during high rate discharge or charge can be a major design problem for large, high energy density battery systems. A systematic approach to the thermal management of such systems is described for different load profiles based on: thermodynamic calculations of internal heat generation; calorimetric measurements of heat flux; analytical and finite difference calculations of the internal temperature distribution; appropriate system designs for heat removal and temperature control. Examples are presented of thermal studies on large lead-acid batteries for electrical utility load levelling and nickel-zinc and lithium-iron sulphide batteries for electric vehicle propulsion. (Author)

A82-24242 **A review of recent developments in thermal batteries.** A. Attewell (Royal Aircraft Establishment, Farnborough, Hants., England) and A. J. Clark (Mine Safety Appliances Co., Ltd., Glasgow, Scotland). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 285-302; Discussion, p. 302, 303. 25 refs.

It is noted that 'thermal battery' is a term applied to a class of reserve-type molten salt electrolyte primary cell systems that are inert until brought into use by the ignition of a charge of

pyrotechnic. Thereafter, the battery remains active for as long as one hour or for only a few seconds, depending on its size, thermal insulation, and electrochemical system and on the ambient temperature and the rate at which power is withdrawn. It is noted that systems using calcium or magnesium as anodes, though inefficient, have been brought to an advanced design and are widely used in weapons systems. The introduction of lithium as an anode material has improved efficiencies and widened performance limits. C.R.

A82-24243 A nickel oxide-iron battery developed for traction purposes - Advantages and limitations. B. Andersson, L. Ojefors (Swedish National Development Co., Akersberga, Sweden), and R. Hudson (Eagle-Picher Industries, Inc., Joplin, MO). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 379-387; Discussion, p. 387, 388. 5 refs. U.S. Department of Energy Contract No. 31-109-38-4292.

The nickel oxide-iron battery described here has successfully proved to be a good candidate for EV battery applications. Based on iron electrode technology and experience of nickel oxide electrodes development work started in May 1978. During the first stage individual cell components were studied, separator systems evaluated and a preliminary cell designed. During the second stage the main work was carried out with 300 A h cells which made it possible to study the important parameters under realistic conditions. The battery design is based on these cell tests. Full scale batteries will be built and tested in electric vehicles during 1980-81. (Author)

A82-24244 A comparison of a low pressure and a high pressure Ni-H2 cell. T. L. Markin, R. Bennett, N. J. Bridger, and R. M. Dell (Atomic Energy Research Establishment, Harwell, Oxon, England). In: Power sources 8: Research and development in non-mecnanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 445-456; Discussion, p. 456, 457.

A low-pressure Ni-H2 cell employing LaNi5 hydrogen storage negative electrodes is described. The charge and discharge characteristics of a low-pressure Ni-H2-10-A h cell are compared with those of a high-pressure Ni-H2 10-A h cell employing Pt-H2 negative electrodes. The characteristics of the low-pressure cell are found to be better than those of the high-pressure Ni-H2 cell at temperatures between 50 C and -20 C but inferior at -40 C. The maximum power at OCV/2 for one minute is found to be better for the low-pressure cell than for the high-pressure Ni-H2 cell at 20 C, but the two are similar at low temperatures. For both cells, self-discharge rates are similar, becoming rapid at 50 C. C.R.

A82-24245 Recent improvements in aircraft Ni-Cd cells. R. Bonnaterre, J. Leonardi, and P. Oliva (Société des Accumulateurs Fixes et de Traction, Bordeaux, France). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 459-468; Discussion, p. 469.

It is noted that the reliability, power performance, and durability of the alkaline Ni-Cd batteries used in such advanced technical fields as aeronautics and high-speed trains are becoming increasingly important. A new aircraft battery generation created to respond to such requirements is described. Increased reliability and durability result from the development and use of a new graft copolymer membrane, the properties of which are discussed. The use of the new membrane and the optimization of the electromechanical parameters of the cell design have significantly improved the power characteristics of Ni-Cd aircraft batteries. In particular, eliminating the 'potential well' phenomenon in low-temperature, high-rate discharges has led to substantial power gains for low-temperature aircraft starts. C.R.

A82-24246 Development of a sealed Ni-Cd cell capable of operating in unprecedented high temperature environments. M. Oshitani, M. Yamane, and S. Hattori (Yuasa Battery Co., Ltd., Osaka, Japan). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 471-487; Discussion, p. 485, 488.

A sealed Ni-Cd cell suitable for use at high temperatures has been developed. Addition of Cd(OH)2 and/or Co(OH)2 in the positive electrode improved charge acceptance at high temperatures, but Co(OH)2 lowered the discharge voltage. Addition of both together gave the best results. Alkali cations, especially Li(+), in the electrolyte improved the charge acceptance. However, a drastic capacity loss occurred in the negative electrode with LiOH solution due to accumulation of Li(+) in the positive electrode. Mixture with other solutions is inevitable. Even at high temperature gamma-Cd(OH)2 was formed when Na(+) was present, while beta-Cd(OH)2 was formed in the other cases. (Author)

A82-24248 A sealed rechargeable metal-oxygen battery for traction purposes. M. Bursell (Kungl. Tekniska Hogskolan, Stockholm, Sweden). In: Power sources 8: Research and development in non-mechanical electrical power sources; Proceedings of the Twelfth International Symposium, Brighton, England, September 1980. London, Academic Press, 1981, p. 513-521. Research supported by the Styrelsen for Teknisk Utveckling.

A prototype of a sealed, rechargeable iron-oxygen battery that is based on a new oxygen electrode design is described, noting that the electrode design has made it possible to considerably simplify construction. It is pointed out that the oxygen electrode can be described as a self-breathing oxygen pocket electrode. It reaches 2 cm above the electrolyte in the battery and is fed with oxygen at the top of the battery by virtue of the pressure difference between the top of the electrode and the bottom. C.R.

A82-24292 Molten nitrate salt technology development. R. W. Carling (Sandia National Laboratory, Livermore, CA). *National Association of Corrosion Engineers, International Corrosion Forum, Toronto, Canada, Apr. 6-10, 1981, Paper.* 7 p. 5 refs.

This paper presents an overview of the experimental programs underway in support of the Thermal Energy Storage for Solar Thermal Applications (TESSTA) program. The experimental programs are concentrating on molten nitrate salts which have been proposed as heat transfer and energy storage medium. The salt composition of greatest interest is drawsalt, nominally a 50-50 molar mixture of NaNO3 and KNO3 with a melting point of 220 C. Several technical uncertainties have been identified that must be resolved before nitrate based solar plants can be commercialized. Research programs at Sandia National Laboratories, universities, and industrial suppliers have been implemented to resolve these technical uncertainties. The experimental programs involve corrosion, decomposition, physical properties, and environmental cracking. Summaries of each project and how they impact central receiver applications such as the repowering/industrial retrofit and cogeneration program are presented. (Author)

A82-25365 † Materials for flywheel energy storage systems (Materialy dlia inertsionnykh nakopitelei energii). I. A. Glebov, E. G. Kasharskii, N. N. Kustov, F. G. Rutberg, A. M. Shkatova, and G. M. Khutoretskii. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport,* Jan.-Feb. 1982, p. 32-37. 14 refs. In Russian.

The paper examines the choice of materials for flywheels to be used as storage units in electrical machinery systems. Particular consideration is given to two extremal problems of flywheel design: assurance of maximum specific energy content (i.e., energy content for unit weight), and assurance of maximum total energy capacity. As an example, attention is given to the fabrication of forged flywheels from the 25KhNZMFA and 35KhNZMFA steels. B.J.

A82-25506 Storage of low temperature heat by thermochemical reactions (Le stockage de la chaleur à basse température par réactions thermochimiques). R. Sizmann, D. Jung, and N. Khelifa (München, Universität, Munich, West Germany). *Coopération Méditerranéenne pour l'Energie Solaire, Revue Internationale d'Héliotechnique,* 2nd Semester, 1981, p. 42-51. 15 refs. In French.

Storage of low temperature solar generated heat by means of thermochemical reactions is reviewed as a method for compensating for diurnal and climatological variations in the solar input. The method is modeled as a separation of two exothermically joined chemicals by the addition of 30-150 C heat. The chemicals can then

be reexposed to one another to release the stored thermal energy on demand. Reactions which result in a liquid and a vapor phase are noted to have the highest thermodynamic efficiency. The hydration of NaS2 necessitates the use of a closed loop system, while a silica gel, which can store up to 400 kWht, ideally, and 200 kWh/cu m in practice, is made from environmentally neutral materials. Details of the silica gel/water vapor storage system are explored, showing an adsorption capacity which makes the material suitable for industrial applications. M.S.K.

A82-26336 **Melt-freeze-cycle life-testing of Glauber's salt in a rolling cylinder heat store.** C. S. Herrick (General Electric Co., Schenectady, NY). *Solar Energy*, vol. 28, no. 2, 1982, p. 99-104. 9 refs. Research supported by the U.S. Department of Energy.

N82-16427# TRW, Inc., McLean, Va.
ALTERNATIVES TO CERAMIC BRICKS AND CERAMIC-BRICK SYSTEMS
J. Michael MacDonald 1981 10 p refs Presented at the Thermal and Chem. Storage Ann. Rev. Meeting, Washington, D.C., 14-16 Sep. 1981
(Contract W-7405-eng-26)
(DE81-032029; CONF-810940-4) Avail: NTIS HC A02/MF A01

Alternative materials for use as thermal energy storage media in electric storage furnaces were evaluated and selected. Selections were based on low cost, availability, durability, and energy storage density. The materials selected were taconite pellets, river gravel, crushed stone, and crushed (air cooled) blast furnace slag. Essential material properties and energy storage densities were established. A conceptual design for an electric storage furnace using these low cost materials was developed. The performance of this conceptual furnace was characterized by an analytical model and a computer code for the model developed. Performance and design comparisons between present day furnaces and the prototype furnace were made. A significant cost advantage for the proposed furnace over existing electric storage furnaces cannot be established. DOE

N82-16521# Exxon Research and Engineering Co., Linden, N.J. Advanced Energy Systems Labs.
DESIGN AND COST ANALYSIS OF A 20-kWh BIPOLAR ZINC-BROMINE BATTERY
Harry Einstein, Richard V. Bellows, Patrick Grimes, Edward Kantner, Paul Malachesky, and Kenneth Newby 1981 4 p refs Presented at 6th Elec. Vehicle Council Symp., Baltimore, 21 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE81-030117; SAND-81-7147C; CONF-811010-4) Avail: NTIS HC A02/MF A01

Exxon's approach to the system uses conductive carbon plastic electrodes in a bipolar configuration, separable bromine complexes, and selective membranes in a circulating electrolyte design. The battery design consists of two kWh battery stacks placed back-to-back with a common center electrolyte feed block. Each of the two battery stacks consists of 78 cells for a system voltage of 120 volt output. Active electrode area per electrode is 12 sq dm cell-to-cell spacing is 0.25 cm. The two-stack module is assembled over a tray serving as a cover for the plastic electrolyte reservoir. Unit cells are comprised of alternating bipolar electrodes and separator assemblies. The projected battery factor price is discussed, along with the manufacturing, materials, and labor costs. T.M.

N82-16526# Technical Univ. of Denmark, Copenhagen. Thermal Insulation Lab.
HEAT STORAGE WITH AN INCONGRUENTLY MELTING SALT HYDRATE AS STORAGE MEDIUM BASED ON THE EXTRA WATER PRINCIPLE
Simon Furbo Dec. 1980 17 p refs
(DE82-901186; DTH-LV-MEDD-108; Rept-8) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries

The extra water principle, a heat of fusion storage method, is described. The extra water principle uses an inorganic, incongruently melting salt hydrate as a reliable and stable storage medium in an inexpensive way. Different heat storages using the extra water principle are described. The advantages of using a heat fusion storage unit based on Na2S2O(3).5H2O and the extra water principle instead of a traditional hot water tank in small solar heating systems for domestic hot water supply are shown. In small solar heating systems the heat fusion storage supplies all the wanted hot water in the summer during longer periods than an ordinary hot water storage. It is concluded that the heat of fusion storage is favorable in domestic hot water supply systems with an auxiliary energy source which during the summer have a large energy consumption compared with the energy demands for the hot water supply. DOE

N82-16536# Oak Ridge Y-12 Plant, Tenn. Nuclear Div.
ROTOR TESTING IN FY 1981
R. S. Steele, Jr. and E. F. Babelay, Jr. 13 Jul. 1981 8 p refs Presented at the Mech., Magnetic and Underground Energy Storage Ann. Contractors' Rev., Washington, D.C., 24-26 Aug. 1981
(Contract W-7405-eng-26)
(DE81-028340; Y/DX-338; CONF-810833-4) Avail: NTIS HC A02/MF A01

Flywheel spin tests conducted for the mechanical energy storage technology project are summarized. Two types of tests are discussed: (1) an ultimate speed test, which includes ultimate speed evaluations for a tapered, quasi isotropic, graphite composite flywheel, a constant thickness disk with an SMC core and circumferentially wound graphite restraining ring, and a constant thickness disk with an S-glass alpha-ply layup core and circumferentially wound graphite ring; (2) a cyclic fatigue test. A matching flywheel was used as the first test unit. Test results and general observations and conclusions are presented. DOE

N82-16945# California Univ., Livermore. Lawrence Livermore Lab.
COMPARISON OF ENERGY-STORAGE DEVICES FOR USE IN FUTURE AUTOMOBILES
L. G. Connell 20 Jun. 1981 11 p refs Presented at Winter Ann. Meeting of the ASME Technol. and Soc. Div., Washington, D.C., 15-20 Nov. 1981 Submitted for publication
(Contract W-7405-eng-48)
(DE81-026530; UCRL-85654; CONF-811101-6) Avail: NTIS HC A02/MF A01

Energy storage devices and their associated propulsion systems which are likely to be capable of providing credible alternatives to current type automotive propulsion systems between now and the year 2000 were studied. It was found that a complete spectrum of automotive performance levels can be achieved by energy storage automobiles during this time period. These range from automobiles with general purpose performance equivalent to internal combustion engine performance to performance suitable for vehicles with specific missions. DOE

N82-17607*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
ELECTROCHEMICAL ENERGY STORAGE FOR AN ORBITING SPACE STATION
R. E. Martin Dec. 1981 61 p refs
(Contract NAS3-21293)
(NASA-CR-165436; FCR-3142) Avail: NTIS HC A04/MF A01 CSCL 10C

The system weight of a multi hundred kilowatt fuel cell electrolysis cell energy storage system based upon alkaline electrochemical cell technology for use in a future orbiting space station in low Earth orbit (LEO) was studied. Preliminary system conceptual design, fuel cell module performance characteristics, subsystem and system weights, and overall system efficiency are identified. The impact of fuel cell module operating temperature and efficiency upon energy storage system weight is investigated. The weight of an advanced technology system featuring high strength filament wound reactant tanks and a fuel cell module employing lightweight graphite electrolyte reservoir plates is defined. E.A.K.

N82-17635# Gould, Inc., Rolling Meadows, Ill.
DEVELOPMENT OF ZINC-BROMINE BATTERIES FOR UTILITY ENERGY STORAGE Monthly Progress Report, Aug. 1981
R. A. Putt 1981 31 p
(Contract DE-AC02-78ET-29345)
(DE82-002114; DOE/ET-29345/T5) Avail: NTIS HC A03/MF A01

Progress is reported on the following tasks related to the development of zinc-bromide batteries: component development and acceptance, hardware design and construction, and testing. Electrode test cell efficiency data and contract management summary reports are presented in tabular form. M.D.K.

N82-17648# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
DESIGN AND SYSTEM LEVEL PERFORMANCE OF A BATTERY CHARGE REGULATOR FOR SOLAR PHOTOVOLTAIC POWERED AIDS TO NAVIGATION
Walter E. Allen. Aug. 1981. 52 p. Sponsored in part by Coast Guard
(PB82-106824; JHU/APL/CP-083) Avail: NTIS HC A04/MF A01 CSCL 10C

The design characteristics of the battery charge regulator in photovoltaic solar powered aids to navigation are reported and are specifically designed to match the electrical characteristics of the solar array and batteries to be used. The regulator, a series high/low rate type using a FET switch, is examined. GRA

N82-18067*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
UPGRADED DEMONSTRATION VEHICLE TASK REPORT
J. Bryant, K. Hardy, R. Livingston, and J. Sandberg. 15 Oct. 1981. 158 p. refs
(Contracts NAS7-100; DE-AI01-78CS-54209)
(NASA-CR-168424; JPL-Pub-81-98; DOE/CS-54209/5) Avail: NTIS HC A08/MF A01 CSCL 13F

Vehicle/battery performance capabilities and interface problems that occurred when upgraded developmental batteries were integrated with upgraded versions of commercially available electric vehicles were investigated. Developmental batteries used included nickel zinc batteries, a nickel iron battery, and an improved lead acid battery. Testing of the electric vehicles and upgraded batteries was performed in the complete vehicle system environment to characterize performance and identify problems unique to the vehicle/battery system. Constant speed tests and driving schedule range tests were performed on a chassis dynamometer. The results from these tests of the upgraded batteries and vehicles were compared to performance capabilities for the same vehicles equipped with standard batteries. S.L.

N82-19678*# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.
RESULTS OF CONTINUOUS SYNCHRONOUS ORBIT TESTING OF SEALED NICKEL-CADMIUM CELLS
J. D. Harkness. 1 Jun. 1981. 472 p. refs
(NASA Order S-53742-AG)
(NASA-CR-168564; WQEC/C-81-120A) Avail: NTIS HC A20/MF A01 CSCL 10C

Test results from continuous synchronous orbit testing of sealed nickel cadmium cells are presented. The synchronous orbit regime simulates a space satellite maintaining a position over a fixed point on earth as the earth rotates on its axis and revolves about the sun. Characteristics of each lot of cells, test conditions, and charge control methods are described. E.A.K.

N82-19689# General Electric Co., Philadelphia, Pa. Energy Systems Programs Dept.
DESIGN AND FABRICATION OF CONTAINMENT RINGS FOR USE IN TESTS OF SIX PROTOTYPE FLYWHEEL ROTORS
Anthony P. Coppa. Feb. 1981. 106 p. refs
(DE81-030357; UCRL-15370) Avail: NTIS HC A06/MF A01

The design of containment rings for use in the prototype flywheel rotor test was examined. Rotor dynamics and failure characteristics were measured. Six designs for prototypes for containment rings are identified. The all metallic and kevlar overwrapped metallic linear containment designs are compared. E.A.K.

N82-19698# Science Research Council, Chilton (England).
THE TECHNIQUES, MAGNITUDES AND OPPORTUNITIES FOR DEVELOPMENT OF ENERGY STORAGE (UK)
F. M. Russell. 1981. 13 p.
(PB82-120858; RL-80-087) Copyright. Avail: NTIS HC A02/MF A01 CSCL 10C

The development of energy storage techniques is discussed. Opportunities for development of existing and new forms of energy storage are examined. The increase in energy transformation with increasing industrialization the need for efficient energy storage and recovery also grows. The large scale transformation of chemical energy stored in fossil fuels emphasizes the need for energy conversion. Techniques of energy storage, applications, and possible research and development areas are also discussed. GRA

N82-20406*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
RECENT TEST RESULTS ON LITHIUM BCX CELLS
B. J. Bragg. *In* NASA. Goddard Space Flight Center. The 1981 GSFC Battery Workshop. Mar. 1982. p 55-75

Avail: NTIS HC A23/MF A01 CSCL 10C

Texts included: short circuit analysis, voltage reversal, high temperature exposure, parallel loading sharing, capacity tests, shock and vibration tests, and assembly tests. Both the AA and D cell configurations were tested. Certification of the cells is discussed and applications are highlighted. T.M.

N82-20407*# Central Intelligence Agency, Gaithersburg, Md.
CASE-POSITIVE VERSUS CASE-NEGATIVE DESIGNS FOR LOW-RATE LITHIUM THIONYL CHLORIDE CELLS
Tyler X. Mahy. *In* NASA. Goddard Space Flight Center. The 1981 GSFC Battery Workshop. Mar. 1982. p 77-90

Avail: NTIS HC A23/MF A01 CSCL 10C

Case polarity design choices are discussed. Two examples of case-negative designs are presented. One battery is thionyl chloride limited and the other is lithium limited. The case-positive design is thionyl chloride limited. It is found that the case-positive/case-negative design consideration does not seem to have much bearing on storage. However, during low rate discharge, the case-negative cells show a steadily decreasing capacity as you go to lower and lower rates. T.M.

N82-20414*# Naval Surface Weapons Center, White Oak, Md.
NAVY POSITION ON LITHIUM SAFETY
Frank Bis. *In* NASA. Goddard Space Flight Center. The 1981 GSFC Battery Workshop. Mar. 1982. p 157-163

Avail: NTIS HC A23/MF A01 CSCL 10C

The Navy's position on safety of lithium batteries is discussed. Testing includes: short circuit with all fuses bypassed; forced discharge at the fuse value; and a modified incineration test. L.F.M.

N82-20415*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DESTRUCT/NON-DESTRUCT EVALUATION OF CYCLED NiCd CELLS
Salvador DiStefano. *In* NASA. Goddard Space Flight Center. The 1981 GSFC Battery Workshop. Mar. 1982. p 165-176

Avail: NTIS HC A23/MF A01 CSCL 10C

AC impedance techniques are discussed for a non-destruct analysis of nickel cadmium batteries. A technique for determining battery cycle life is the ultimate goal. L.F.M.

N82-20416*# Villanova Univ., Pa. Dept. of Chemistry.
ELECTROCHEMICAL MODELS FOR THE DISCHARGE CHARACTERISTICS OF THE NiCd CELL
Michael S. Spritzer. *In* NASA. Goddard Space Flight Center. The 1981 GSFC Battery Workshop. Mar. 1982. p 177-188

Avail: NTIS HC A23/MF A01 CSCL 10C

Models are developed and discussed as a technique for evaluating the discharge characteristics of the nickel cadmium battery. Results are compared with available experimental data. L.F.M.

N82-20417*# Rockwell International Corp., Seal Beach, Calif.
NiCd BATTERY FAILURE ANALYSIS
Karl A. Sense. *In* NASA. Goddard Space Flight Center. The 1981 GSFC Battery Workshop. Mar. 1982. p 189-200

Avail: NTIS HC A23/MF A01 CSCL 10C

The failure of a nickel cadmium battery undergoing tests is discussed. Reasons for the complete destruction of the battery while undergoing preparation for thermal vacuum testing are given. L.F.M.

N82-20427*# Martin Marietta Aerospace, Pasadena, Calif.
RCA SATCOM IN-ORBIT EXPERIENCE: AN UPDATE
David Stewart. *In* NASA. Goddard Space Flight Center. The 1981 GSFC Battery Workshop. Mar. 1982. p 317-326

Avail: NTIS HC A23/MF A01 CSCL 10C

The SATCOM in-orbit battery performance was evaluated. The capacitance and constant current charge rates for each of the three batteries were monitored. A typical eclipse discharge profile was generated and attendant reconditioning recharge conditions were considered. Battery temperatures, pressures, and average battery voltages are presented in tabular form. In-orbit data from monitoring the end of discharge voltage during eclipses, a key performance parameter, are also given. M.D.K.

N82-20428*# Martin Marietta Aerospace, Pasadena, Calif.
UPDATE: VIKING LANDER NiCd BATTERIES. YEAR SIX
A. O. Britting, Jr. *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 327-339

Avail: NTIS HC A23/MF A01 CSCL 10C

The performance of NiCd batteries on the Viking Mars landers is discussed. During evaluation, three of the four batteries were maintained in the discharged state. Battery charge regimes and close-together, deep-discharge, reconditioning cycles to retard degradation of batteries are discussed. The effect of elevated temperatures during Martian summer on battery performance were also considered. Tabulated data for average battery capacity as a function of time are given. A design uplink to allow more frequent, greater depth of discharge reconditioning cycles was proposed. M.D.K.

N82-20429*# Rockwell International Corp., Downey, Calif.
GPS ON-ORBIT BATTERY PERFORMANCE
John L. Kasten *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 341-352

Avail: NTIS HC A23/MF A01 CSCL 10C

Three batteries designed for the GPS system were evaluated. The batteries were wired together, and during the eclipse period were discharged through parallel diodes into a boost converter which then boosted the battery voltage up to the totally regulated bus voltage. Each battery, with a system life of approximately five years, had its own charger. During testing the battery was maintained or used on trickle charge. Data are presented for the battery capacity during the reconditioning. Raw data for each eclipse period and calculations for the average discharge voltage for each battery are given. Thermal cycling for one of the batteries and reconditioning cycles and regimes for all of the batteries are discussed. A reconditioning discharge curve is also given. The problem of temperature cycling in one of the batteries was resolved by redesigning the battery radiator system. M.D.K.

N82-20431*# Bell Telephone Labs., Inc., Murray Hill, N. J.
EFFECTS OF THE MODE OF STORAGE ON THE CAPACITY FADING OF THE SINTERED NICKEL ELECTRODES
B. Vyes and M. P. Bernhardt *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 367-386

Avail: NTIS HC A23/MF A01 CSCL 10C

A systematic investigation of the effect of temperature and two conditions of storage, shortened and open circuit, on the capacity fading of sintered nickel electrodes in NiCd batteries was conducted. All testing was done on sintered electrodes in flooded cells. Cycling tests to measure the capacity were performed at room temperature. The capacity out to one volt, a capacity useful for satellite applications. Test results indicated that: the shortened electrode showed a higher rate of loss than the open circuit electrodes; there was an increase in both modes with an increase in temperature; there was a loss of capacity with time of storage; a general degradation was observed as a function of time; shortened electrodes showed a higher end of charge than the open circuit ones; and at room temperature there was a lower loss in the open circuit electrode than in the shortened one. M.D.K.

N82-20436*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPARISONS OF DIFFERENT PLATE TREATMENT AND DESIGNS: AN UPDATE
David Baer *In its* The 1981 GSFC Battery Workshop Mar. 1982 p 435-442

Avail: NTIS HC A23/MF A01 CSCL 10C

Nine groups of cells were studied. The first group was the control. The basic design was cadmium in the positive plate, and no negative treatment. The plate loading level was the IUE. The separator was pellon. The test regime for the remaining cells was a 90 minute cycle with 40% depth of discharge and a temperature of 20 C. The charge rate was 9.6 amps to a voltage limit. The discharge rate was 9.6 amps. N.W.

N82-20437*# Bowie State Coll., Md.
COMPARISONS OF DIFFERENT PLATE TREATMENTS AND DESIGNS: ANALYSIS
Vasanth Kunigahelli *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 443-458

Avail: NTIS HC A23/MF A01 CSCL 10C

The design and process changes on cell performance and life were studied. The merits of each design were analyzed physically, chemically, and electrochemically. A teardown analysis of each cell was carried out. On opening the cell it was found that the cell pack was moist with the electrolyte, the extent varying from one cell to another. The cell components, the positives, the negatives, and the separators, could be separated easily for cell pack of an uncycled cell. The separators from the uncycled cell were clean and white. In the case of cycled cells the separators were stuck to the surface of the negative plates. During the removal of these separators from the negative plates invariably a thin layer of the separator material was strongly adhering to the surface of the negative plates and could not be removed as easily as in the case of the uncycled cells. The separators had dark patches due to cadmium migration. N.W.

N82-20438*# Bell Telephone Labs., Inc., Murray Hill, N. J.
CHARGEABILITY OF NICKEL ELECTRODES STUDIED BY OPTICAL MICROSCOPY
C. K. Dyer *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 459-470

Avail: NTIS HC A23/MF A01 CSCL 10C

Some of the operational characteristics of some nickel hydrogen cells are explained. Some strange capacity excursions with cycling were seen. N.W.

N82-20440*# Communications Satellite Corp., Clarksburg, Md.
COMSAT LABS LIFE TEST DATA FOR NiH2 CELLS
Joseph Stockel *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 481-485

Avail: NTIS HC A23/MF A01 CSCL 10C

Data concerning a ten cell nickel hydrogen battery are presented. The plates are electrochemically impregnated using slurry plaque. N.W.

N82-20441*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
LIFE TEST OF 50 AH NiH2 BATTERY
Don H. Warnoc *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 487-499

Avail: NTIS HC A23/MF A01 CSCL 01C

Life cycle testing on a battery is reported. The cells were built in 1975, put into battery in 1976, and flown in 1977 in low Earth orbit. N.W.

N82-20442*# TRW, Inc., Redondo Beach, Calif.
CYCLING CHARACTERISTICS ON NiH2 CELLS IN STANDARD AND DAILY ENERGY BALANCE LEO ORBITS
Paul Ritterman *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 501-512

Avail: NTIS HC A23/MF A01 CSCL 01C

A plot of end-of-charge and end-of-discharge voltage versus the number of cycles completed, and end-of-charge and end-of-discharge pressure versus cycles completed are presented. N.W.

N82-20443*# Hughes Aircraft Co., Los Angeles, Calif.
SOME PROPERTIES OF NiH2 CELLS
Howard H. Rogers *In* NASA. Goddard Space Flight Center The 1981 GSFC Battery Workshop Mar. 1982 p 513-524

Avail: NTIS HC A23/MF A01 CSCL 10C

Different tests on a flight type cell are discussed. The temperature was measured at the cell flange. The cell was charged to rollover at .75 C rate at 40 degrees C for the first temperature. At that point a voltage reading was taken. Charging was done for an arbitrary ten seconds at .75 C, 30 C, 20 C, 10 C and zero C to obtain momentarily stable voltages. N.W.

N82-20676# Hydrologic Engineering Center, Davis, Calif.
USE OF NON-SEQUENTIAL TECHNIQUES IN THE ANALYSIS OF POWER POTENTIAL AT STORAGE PROJECTS
Gary M. Franc Jun. 1981 19 p refs Presented at the Waterpower 81st Conf., Washington, D.C., Jun. 1981
(AD-A109788; HEC-TP-80) Avail: NTIS HC A02/MF A01 CSCL 10/2

An electronic computer procedure is described that uses an estimate of power storage available at a dam site to make estimates of average annual energy and dependable capacity using a non-sequential methodology. Comparisons of this method against the more traditional sequential routing analysis are performed. Author (GRA)

N82-20687# United Technologies Research Center, East Hartford, Conn.
TECHNICAL AND ECONOMIC ASSESSMENT OF FLUIDIZED-BED-AUGMENTED COMPRESSED AIR ENERGY-STORAGE SYSTEM. VOLUME 3: PRECONCEPTUAL DESIGN
A. J. Giramonti, R. D. Lessard, D. Merrick (Coal Processing Consultants Ltd.), and M. J. Hobson (Acres American Inc.) Sep. 1981 251 p refs Prepared for Pacific Northwest Lab.
(Contract DE-AC06-77RL-01830)
(DE82-001945; PNL-3686-Vol-3) Avail: NTIS HC A12/MF A01

A technical and economic assessment of fluidized bed combustion augmented compressed effort are presented in three volumes. Volume III - Preconceptual Design contains the system analysis which led to the identification of a preferred component configuration for a fluidized bed combustion augmented compressed air energy storage system, the results of the effort which transformed the preferred configuration into preconceptual power plant design, and an introductory evaluation of the performance of the power plant system during part-load operation and while load following. DOE

N82-21725# Rocketdyne, Canoga Park, Calif. Flywheel Systems.
RPE-10 COMPOSITE FLYWHEEL TESTING Final Report
B. R. Ginsburg Livermore, Calif. California Univ. Lawrence Livermore Lab. 15 Jun. 1981 47 p refs
(Contract W-7405-eng-48)
(DE82-001694; UCRL-15379) Avail: NTIS HC A03/MF A01

The final report on the technical effort to test an RPE-10 composite flywheel is described. The RPE-10 composite flywheel was designed and fabricated for vehicle use under a Sandia Laboratories contract. The flywheel (Unit No. 2) was tested to a speed of 21,600 rpm, at which time the overwrap separated from the flywheel, terminating the test. The primary cause of failure was attributed to overheating in the test cell, causing a deterioration in material properties of the epoxy bond. The RPE-10 composite flywheel Unit No. 1 was successfully tested without failure to 24,120 rmp at Oak Ridge's Y-12 Laboratory. At this speed, the rotor stored over 2.0 kilowatt hours of kinetic energy. DOE

N82-21763# United Engineers and Constructors, Inc., Philadelphia, Pa.
PRELIMINARY ENGINEERING DESIGN AND COST OF ADVANCED COMPRESSED-AIR STORAGE (ACAS) A-5 HYBRID Final Report
E. J. Sosnowicz, J. Blackman (Brown Boveri Corp., North Brunswick, N.J.), A. S. Woodhull, and P. Zaugg Aug. 1981 272 p refs
(EPRI Proj. 1699-1)
(DE82-900339; EPRI-EM-1998) Avail: NTIS HC A12/MF A01

The advanced compressed air energy (ACAS) plant investigated operates on a partial adiabatic, partial fuel fired cycle. Only a limited advancement in state-of-the-art technology is projected for this hybrid arrangement. The A-5 hybrid systems stores the heat of compression from the low pressure and intermediate pressure compressors in a thermal energy store (TES). The heat collected in the TES is available for preheating the air from the storage cavern prior to its entering the low pressure turbine combustor. This reduces the amount of fuel consumed during power generation. The fuel heat rate for the hybrid cycle is 2660 Btu/kWh as compared to approximately 4000 Btu/kWh for a conventional CAES plant. A virtual stand-off between the hybrid plant and a conventional CAES plant at 235 mills/kWh in 1980 dollars is shown. With a lower cost and increased fuel cost projections, the hybrid system operating cost is less than that for a conventional CAES plant. T.M.

N82-21766# Stuttgart Univ. (West Germany). Abt. Energieumwandlung und Waermetechnik.
HEAT STORAGE BY MEANS OF THERMAL DISSOCIATION REACTIONS. STORAGE SYSTEMS AND MATERIALS [WAERMESPEICHERUNG DURCH THERMISCHE DISSOZIATIONSREAKTIONEN - SPEICHERSYSTEME UND SPEICHERMATERIALEN]
A. Nonnenmacher May 1980 50 p refs In GERMAN; ENGLISH summary
(IKE-5-213; ISSN-0173-6892) Avail: NTIS HC A03/MF A01

The reversible chemical reactions used for heat storage are classified, according to the phase of the dissociation products and storage techniques, pertaining to the respective phases. The physical principles of heat storage, the relevant thermal dissociation reactions and adsorption cycles are reviewed and the most important working media for the different reaction groups are summarized. The interaction with the storage materials is investigated and reactions of gases and fluids with solids and liquids are emphasized. Storage by adsorption media is also envisaged. Author (ESA)

N82-21772# Science Research Council, Chilton (England).
ENERGY STORAGE: A SHORT LIST OF INTERESTED PARTIES, 1981 AND THE STORAGE OF ENERGY; A WALL CHART
F. M. Russell 1981 29 p refs
(PB82-132069; RL-81-067) Copyright Avail: NTIS HC A03/MF A01 CSCL 10C

The storage of energy is an important feature of all industrialized activity and is increasing in importance rapidly as attempts are made to conserve energy and to use energy more efficiently in both industrial and domestic applications. In April 1981 an International Conference on Energy Storage was co-sponsored by SERC, BHRA and ETSU. As part of the SERC contribution to that conference an analysis was made of the activities and interests of the conference participants relevant to energy storage. This short list of parties interested in energy storage was made available to conference delegates but it is believed that a wider distribution of this information may be of use to others who may be either currently active or contemplating initiating work in this area. GRA

08
GENERAL

A82-20876 **Space in the 1980's and beyond; Proceedings of the Seventeenth European Space Symposium, London, England, June 4-6, 1980.** Symposium sponsored by the Association Aéronautique et Astronautique de France, Deutsche Gesellschaft für Luft- und Raumfahrt, American Astronautical Society, et al. Edited by P. M. Bainum (Howard University, Washington, DC). San Diego, CA, American Astronautical Society (Science and Technology Series. Volume 53); Univelt, Inc., 1981. 302 p. $40.

Topics discussed include a long-term space program for Europe, space communications, space transportation, applications, and technology, and lunar and planetary exploration. Papers are presented on manufacturing in space, on the contributions of space reflector technology to food production, local weather manipulation, and energy supply, and on a technological approach towards future large solar arrays. Attention is also given to low-pressure greenhouses and plants for a manned research station on Mars, to the extraction of Martian resources for a manned research station, and to the development of future lunar exploration. C.R.

A82-28112 **AIP 50th anniversary: Physics vade mecum.** Edited by H. L. Anderson (Los Alamos National Laboratory, Los Alamos, NM). New York, American Institute of Physics, 1981. 335 p.

This compendium is intended to be of use to the wide spectrum of physicists associated with the AIP through its member societies. Twenty-two subjects broadly representative of physics as a whole are discussed. Each subeditor was charged to compile within 10 pages the most useful information, formulas, numerical data, definitions, and references most physicists would like to have at hand. The General Section is a compilation of the fundamental constants, the SI units and prefixes, conversion factors, magnitudes, basic mathematical and physics formulas, formulas useful in practical physics applications, and a list of physics data centers. The particular fields considered are: acoustics, astronomy and astrophysics, atomic collision properties, atomic spectroscopy, biological physics, cryogenics, crystallography, elementary particles, energy demand, energy supply, fluid dynamics, high polymer physics, medical physics, molecular spectroscopy and structure, nuclear physics, optics, plasma physics, rheology, solid state physics, surface physics, and thermophysics. B.J.

N82-16301# GAI Consultants, Inc., Monroeville, Pa.
INVESTIGATION OF THE USE OF COAL REFUSE-FLY ASH COMPOSITIONS AS HIGHWAY BASE COURSE MATERIAL Final Report, Oct. 1977 - Sep. 1980
Paul V. McQuade, W. J. Head, and Robert B. Anderson Jun. 1981 68 p Prepared in cooperation with West Virginia Univ., Morgantown
(Contract DOT-FH-11-9324)
(PB82-101940; FHWA/RD-80/129; Rept-77-522) Avail: NTIS HC A04/MF A01 CSCL 13C

The utilization of coal refuse-fly ash compositions as highway base course material is surveyed. The results of a laboratory testing program into the physical and engineering properties of mixtures of these waste products are presented. A comparison of serviceability index and physical damage parameters based on the VESYS Predictive Design Procedure between crushed stone and coal refuse-fly ash compositions are presented. These findings indicate that substituting stabilized coal refuse-fly ash blends in place of conventional base course material is technically and economically feasible. Procedures for developing design mixes and conducting field tests of coal refuse-fly ash base course material are described. Author

N82-20138# Office of Naval Research, London (England).
EUROPEAN SCIENTIFIC NOTES, VOLUME 35, NUMBER 11 Monthly Publication Report, 30 Nov. 1981
Francis A. Richards, ed. and Don J. Peters, ed. 30 Nov. 1981 37 p
(AD-A109387; ESN-35-11) Avail: NTIS HC A03/MF A01 CSCL 05/1

A collection of articles on recent developments in European scientific research is presented. The following topics are discussed: Artificial and Human Intelligence; Organizational Change in Merchant Shipping; Unit of Blood Pressure: Protecting the Millimeter of Mercury; Third International Symposium on Inorganic Ring Systems; NATO Advanced Research Institute on Surface Modification and Alloying of Materials by Direct Energy Processing; and FRAM Ice Floe Stations. E.A.K.

N82-20315# National Inst. for Transport and Road Research, Pretoria (South Africa).
THE DEVELOPMENT OF PVC-MODIFIED TARS FOR USE IN SURFACE TREATMENTS
I. L. Jamieson 1981 75 p refs
(CSIR-RR-393; CSIR-B-14) Avail: NTIS HC A04/MF A01

An account of this research in improving the durability of tar is presented. It includes: the formulation of tars; the manufacture of tars and modified tars; the storage and handling of tars; the performance of PVC modified tars in surface treatments; road experiments and normal contract work. The development of improved tar binders which could be used as alternatives to petroleum bitumen, with considerable cost advantage to road authorities was considered. Practical points which have emerged from this research are included. Author

N82-22099# Committee on Information Hang-Ups, Washington, D.C. Energy Systems Group.
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Ellen L. Berman 1981 162 p
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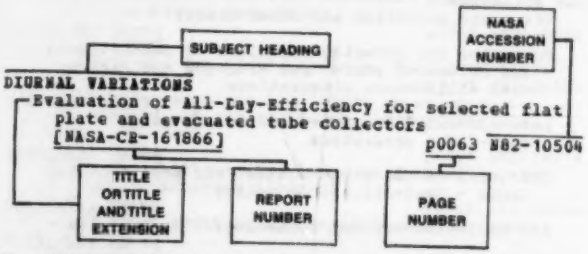

The subject heading is a key to the subject content of the document. The title, and title extension if used, provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any subject heading the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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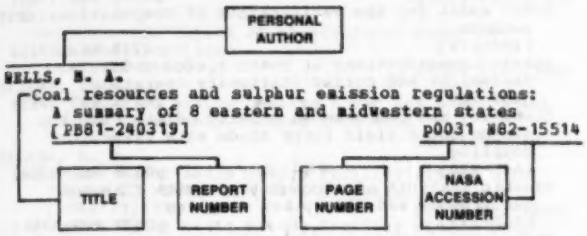

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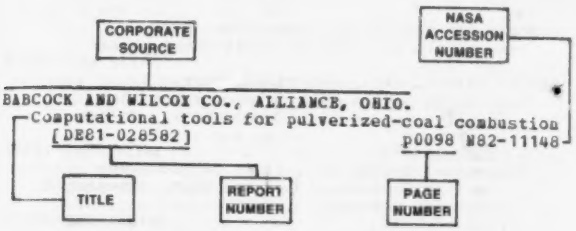

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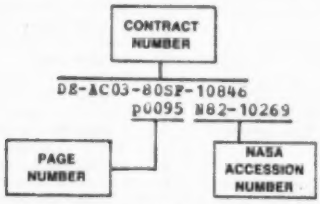

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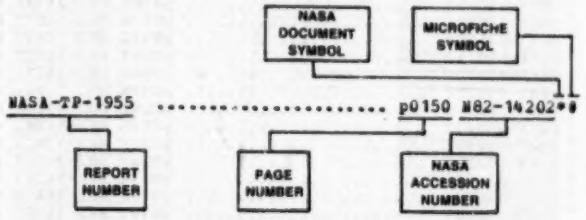

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AD-A108385 ..... p0229 N82-19686 #
AD-A108386 ..... p0229 N82-19687 #
AD-A108463 ..... p0180 N82-18207 #
AD-A108889 ..... p0229 N82-19688 #
AD-A109038 ..... p0232 N82-20671 #
AD-A109039 ..... p0232 N82-20672 #
AD-A109387 ..... p0295 N82-20138 #
AD-A109393 ..... p0185 N82-20025 #
AD-A109477 ..... p0232 N82-20674 #
AD-A109772 ..... p0283 N82-20678 #
AD-A109788 ..... p0294 N82-20676 #
AD-A109790 ..... p0187 N82-20693 #
AD-A109877 ..... p0261 N82-21111 #
AD-A110021 ..... p0262 N82-21426 #
AD-A110189 ..... p0233 N82-21718 #
AD-A110305 ..... p0262 N82-21424 #
AD-A110337 ..... p0285 N82-21719 #

ADL-85161 ..... p0240 N82-19196*#

AEL-0039-TR ..... p0282 N82-19681 #

AESD-TME-3065 ..... p0259 N82-20333 #

AFAMRL-TR-81-101 ..... p0187 N82-20693 #

AFESC/ESL-TR-81-13 ..... p0262 N82-21424 #

AFIT-LSSR-58-81 ..... p0261 N82-21111 #

AFLRL-150 ..... p0262 N82-21426 #

AGARD-CP-302 ..... p0277 N82-17203 #

AGESS-810513 ..... p0171 N82-16467 #

AIAA PAPER 81-0811 ..... p0165 A82-20874*#
AIAA PAPER 82-0069 ..... p0198 A82-22040 #
AIAA PAPER 82-0324 ..... p0269 A82-19794 #
AIAA PAPER 82-0326 ..... p0269 A82-19795 #
AIAA PAPER 82-0376 ..... p0269 A82-19800 #
AIAA PAPER 82-0378 ..... p0165 A82-22097 #
AIAA PAPER 82-0396 ..... p0270 A82-20292*#

AIRESEARCH-31-3725 ..... p0276 N82-16937*#
AIRESEARCH-80-17527 ..... p0230 N82-20643*#
AIRESEARCH-81-18087 ..... p0230 N82-20642*#

ANL-CEN-PR-81-7 ..... p0249 N82-17317 #

ANL-EES-TM-153 ..... p0173 N82-16566 #

ANL-SPG-17 ..... p0177 N82-17634 #

ANL-TRANS-1198 ..... p0175 N82-16946 #
ANL-TRANS-1199 ..... p0179 N82-18071 #

ANL-81-16 ..... p0285 N82-21722 #
ANL-81-55 ..... p0223 N82-16528 #

ANL/CNSV-TM-82 ..... p0172 N82-16523 #
ANL/CNSV-TM-85 ..... p0260 N82-20680 #
ANL/CNSV-14 ..... p0170 N82-16259 #
ANL/FE-81-51 ..... p0172 N82-16559 #
ANL/FE-81-64 ..... p0260 N82-20492 #
ANL/MHD-80-6 ..... p0276 N82-16901 #
ANL/MHD-81-1 ..... p0276 N82-16900 #
ANL/SPG-20 ..... p0233 N82-21721 #

AR-1 ..... p0251 N82-17507 #
AR-001-672 ..... p0282 N82-19681 #
AR-002-170 ..... p0262 N82-21416 #

ARB-R-81/40 ..... p0183 N82-18757 #

ASME PAPER 81-WA/DSC-10 ..... p0273 A82-24564 #
ASME PAPER 81-WA/HT-2 ..... p0242 A82-24584 #
ASME PAPER 81-WA/HT-13 ..... p0214 A82-24589 #
ASME PAPER 81-WA/SAP-3 ..... p0166 A82-24604 #
ASME PAPER 81-WA/SOL-2 ..... p0214 A82-24605 #
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ASME PAPER 81-WA/SOL-5 ..... p0214 A82-24607 #
ASME PAPER 81-WA/SOL-6 ..... p0214 A82-24608 #
ASME PAPER 81-WA/SOL-7 ..... p0214 A82-24609 #
ASME PAPER 81-WA/SOL-10 ..... p0214 A82-24610 #
ASME PAPER 81-WA/SOL-12 ..... p0215 A82-24611 #
ASME PAPER 81-WA/SOL-13 ..... p0215 A82-24612 #
ASME PAPER 81-WA/SOL-14 ..... p0215 A82-24613 #
ASME PAPER 81-WA/SOL-15 ..... p0215 A82-24614 #
ASME PAPER 81-WA/SOL-16 ..... p0215 A82-24615 #
ASME PAPER 81-WA/SOL-17 ..... p0215 A82-24616 #
ASME PAPER 81-WA/SOL-18 ..... p0215 A82-24617 #
ASME PAPER 81-WA/SOL-22 ..... p0216 A82-24620*#
ASME PAPER 81-WA/SOL-23 ..... p0216 A82-24621 #
ASME PAPER 81-WA/SOL-24 ..... p0216 A82-24622*#
ASME PAPER 81-WA/SOL-25 ..... p0216 A82-24623 #
ASME PAPER 81-WA/SOL-27 ..... p0216 A82-24624*#
ASME PAPER 81-WA/SOL-28 ..... p0216 A82-24625 #
ASME PAPER 81-WA/SOL-30 ..... p0216 A82-24626 #
ASME PAPER 81-WA/SOL-32 ..... p0217 A82-24627 #
ASME PAPER 81-WA/SOL-34 ..... p0217 A82-24628*#

BETC/OP-81/52 ..... p0170 N82-16417 #

BLL-CTO-1921-(9091.9F) p0284 N82-21063

BLN/YW/SR-81/02 ..... p0256 N82-18800 #

BM-IC-8849 ..... p0260 N82-20632 #

BM-OFR-126-81 ..... p0251 N82-17450 #

BM-RI-8539 ..... p0174 N82-16614 #

BMFT-FB-T-80-043-E ..... p0236 N82-21769 #
BMFT-FB-T-81-145 ..... p0288 N82-18710 #
BMFT-FB-T-81-174 ..... p0230 N82-19690 #
BMFT-FB-T-81-175 ..... p0181 N82-18552 #
BMFT-FB-T-81-177 ..... p0256 N82-18712 #
BMFT-FB-T-81-178 ..... p0227 N82-18713 #
BMFT-FB-T-81-179 ..... p0227 N82-18714 #
BMFT-FB-T-81-180 ..... p0282 N82-19691 #
BMFT-FB-T-81-181 ..... p0230 N82-19692 #
BMFT-FB-T-81-182 ..... p0230 N82-19693 #
BMFT-FB-T-81-183 ..... p0227 N82-18715 #
BMFT-FB-T-81-184 ..... p0227 N82-18716 #
BMFT-FB-T-81-186 ..... p0228 N82-18717 #
BMFT-FB-T-81-193 ..... p0228 N82-18718 #
BMFT-FB-T-81-204 ..... p0257 N82-19319 #
BMFT-FB-T-81-221 ..... p0251 N82-17455 #
BMFT-FB-T-81-222 ..... p0250 N82-17391 #

BNR-BOLL-208 ..... p0254 N82-17696

BNL-29962 ..... p0240 N82-16270 #
BNL-29963 ..... p0223 N82-16518 #
BNL-30046 ..... p0170 N82-16458 #
BNL-51430 ..... p0260 N82-20696 #

CAEC-400-81-005 ..... p0188 N82-21448 #

CANNET-79-29 ..... p0189 N82-22020 #

CEL-CR-82.002-VOL-1 ..... p0229 N82-19683 #
CEL-CR-82.004-VOL-3 ..... p0229 N82-19685 #
CEL-CR-82.005-VOL-4 ..... p0229 N82-19686 #
CEL-CR-82.006 ..... p0229 N82-19687 #
CEL-CR-82.007 ..... p0233 N82-21718 #

CEL-TN-1613 ..... p0285 N82-21719 #

CISE-1713 ..... p0225 N82-18529 #

CONF-801030-VOL-1 ..... p0245 N82-16273 #
CONF-801030-VOL-2 ..... p0245 N82-16274 #
CONF-801176-1 ..... p0249 N82-16557 #
CONF-810250 ..... pC171 N82-16504 #
CONF-810833-4 ..... p0291 N82-16536 #
CONF-810923-9 ..... p0249 N82-16918 #
CONF-810923-10 ..... p0247 N82-16375 #
CONF-810940-3 ..... p0240 N82-16270 #
CONF-810940-4 ..... p0291 N82-16427 #
CONF-810965-1 ..... pC171 N82-16507 #
CONF-811010-4 ..... p0291 N82-16521 #
CONF-811030-2 ..... p0223 N82-16518 #
CONF-811101-3 ..... p0222 N82-16505 #
CONF-811101-6 ..... p0291 N82-16945 #
CONF-811101-9 ..... p0223 N82-16511 #
CONF-811108-3 ..... p0246 N82-16277 #
CONF-811108-5 ..... p0244 N82-16205 #
CONF-811109-1 ..... p0222 N82-16500 #
CONF-7911154 ..... p0171 N82-16513 #
CONF-8006187-1 ..... p0245 N82-16264 #
CONF-8104103 ..... p0169 N82-16057 #

CRREL-SR-81-23 ..... p0256 N82-18469 #
CRREL-SR-81-24 ..... p0256 N82-18790 #

CSIR-B-14 ..... p0295 N82-20315 #

CSIR-ME-436 ..... p0224 N82-16544 #
CSIR-ME-1705 ..... p0228 N82-18722 #

CSIR-MR-393 ..... p0295 N82-20315 #

CW-WR-76-020.74A ..... p0264 N82-21591 #

C4100-50 ..... p0226 N82-18698*#

DCN-81-207-001-60 ..... p0245 N82-16272 #

DDA-ADR-10086 ..... p0275 N82-16485*#

DE-82-001936 ..... p0232 N82-20684*#

DE81-03093 ..... p0232 N82-21345*#
DE81-023606 ..... p0222 N82-16500 #
DE81-025062 ..... p0188 N82-20700 #
DE81-025726 ..... p0223 N82-16511 #
DE81-026530 ..... p0291 N82-16945 #
DE81-026975 ..... p0224 N82-16542 #
DE81-027337 ..... p0174 N82-16846 #
DE81-027358 ..... p0259 N82-20334 #
DE81-027613 ..... p0171 N82-16504 #
DE81-027804 ..... p0246 N82-16277 #
DE81-028340 ..... p0291 N82-16536 #
DE81-028366 ..... p0258 N82-20280 #
DE81-028406 ..... p0169 N82-16057 #
DE81-028435 ..... p0173 N82-16565 #
DE81-028536 ..... p0249 N82-16560 #
DE81-028756 ..... p0258 N82-20284 #
DE81-029631 ..... p0244 N82-16210 #
DE81-029791 ..... p0259 N82-20333 #
DE81-030004 ..... p0264 N82-21780 #
DE81-030030 ..... p0223 N82-16518 #
DE81-030031 ..... p0240 N82-16270 #
DE81-030052 ..... p0223 N82-16538 #
DE81-030059 ..... p0264 N82-21591 #
DE81-030072 ..... p0179 N82-18071 #
DE81-030098 ..... p0172 N82-16537 #
DE81-030117 ..... p0291 N82-16521 #
DE81-030157 ..... p0244 N82-16211 #
DE81-030287 ..... p0175 N82-16946 #
DE81-030357 ..... p0292 N82-19689 #
DE81-030437 ..... p0175 N82-16943 #
DE81-030531 ..... p0225 N82-17633 #
DE81-030545 ..... p0249 N82-16557 #
DE81-030681 ..... p0174 N82-16767 #
DE81-030734 ..... p0170 N82-16458 #
DE81-030807 ..... p0171 N82-16507 #
DE81-030839 ..... p0249 N82-16918 #
DE81-030849 ..... p0251 N82-17402 #
DE81-030965 ..... p0261 N82-21279 #
DE81-030968 ..... p0175 N82-16942 #
DE81-031928 ..... p0174 N82-16935 #
DE81-031987 ..... p0188 N82-21760 #
DE81-032029 ..... p0291 N82-16427 #
DE81-903440 ..... p0245 N82-16264 #
DE81-903753 ..... p0245 N82-16273 #
DE81-903754 ..... p0245 N82-16274 #
DE81-904202 ..... p0248 N82-16539 #
DE81-904228 ..... p0171 N82-16513 #
DE81-904235 ..... p0250 N82-17398 #
DE82-000030 ..... p0250 N82-17397 #
DE82-000033 ..... p0223 N82-16527 #
DE82-000092 ..... p0235 N82-21746 #
DE82-000127 ..... p0264 N82-21761 #
DE82-000137 ..... p0249 N82-17314 #
DE82-000143 ..... p0262 N82-21427 #
DE82-000223 ..... p0245 N82-16271 #
DE82-000228 ..... p0236 N82-22073 #
DE82-000230 ..... p0245 N82-16272 #
DE82-000274 ..... p0246 N82-16284 #
DE82-000292 ..... p0224 N82-16540 #
DE82-000294 ..... p0170 N82-16265 #
DE82-000318 ..... p0172 N82-16514 #
DE82-000347 ..... p0247 N82-16375 #
DE82-000387 ..... p0244 N82-16213 #
DE82-000412 ..... p0250 N82-17396 #
DE82-000416 ..... p0171 N82-16461 #
DE82-000454 ..... p0223 N82-16533 #
DE82-000456 ..... p0222 N82-16499 #
DE82-000462 ..... p0244 N82-16205 #
DE82-000479 ..... p0170 N82-16266 #
DE82-000499 ..... p0172 N82-16516 #
DE82-000535 ..... p0248 N82-16517 #
DE82-000595 ..... p0247 N82-16285 #
DE82-000632 ..... p0250 N82-17395 #
DE82-000633 ..... p0236 N82-21753 #
DE82-000637 ..... p0223 N82-16531 #
DE82-000653 ..... p0232 N82-21442 #
DE82-000666 ..... p0276 N82-16522 #
DE82-000689 ..... p0281 N82-18705 #
DE82-000690 ..... p0280 N82-18704 #
DE82-000738 ..... p0234 N82-21730 #
DE82-000762 ..... p0249 N82-17315 #
DE82-000763 ..... p0246 N82-16282 #
DE82-000770 ..... p0246 N82-16283 #
DE82-000802 ..... p0245 N82-16269 #
DE82-000833 ..... p0233 N82-21542 #
DE82-000838 ..... p0254 N82-17630 #
DE82-000839 ..... p0254 N82-17631 #
DE82-000868 ..... p0224 N82-16543 #
DE82-000874 ..... p0248 N82-16529 #
DE82-000881 ..... p0245 N82-16263 #
DE82-000883 ..... p0248 N82-16501 #
DE82-000887 ..... p0170 N82-16259 #
DE82-000892 ..... p0261 N82-21281 #
DE82-000896 ..... p0247 N82-16465 #
DE82-000898 ..... p0173 N82-16562 #
DE82-000913 ..... p0253 N82-17573 #

DE82-000916 ..... p0252 N82-17572 #
DE82-000949 ..... p0247 N82-16464 #
DE82-000994 ..... p0225 N82-17632 #
DE82-001037 ..... p0246 N82-16278 #
DE82-001038 ..... p0263 N82-21432 #
DE82-001047 ..... p0173 N82-16563 #
DE82-001069 ..... p0276 N82-16525 #
DE82-001076 ..... p0245 N82-16228 #
DE82-001104 ..... p0258 N82-20281 #
DE82-001127 ..... p0251 N82-17401 #
DE82-001143 ..... p0182 N82-18701 #
DE82-001153 ..... p0247 N82-16381 #
DE82-001328 ..... p0253 N82-17629 #
DE82-001348 ..... p0253 N82-17576 #
DE82-001356 ..... p0247 N82-16462 #
DE82-001578 ..... p0227 N82-18702 #
DE82-001605 ..... p0174 N82-16845 #
DE82-001606 ..... p0233 N82-21720 #
DE82-001608 ..... p0276 N82-16900 #
DE82-001617 ..... p0173 N82-16566 #
DE82-001628 ..... p0235 N82-21743 #
DE82-001657 ..... p0235 N82-21738 #
DE82-001661 ..... p0261 N82-21280 #
DE82-001663 ..... p0234 N82-21733 #
DE82-001669 ..... p0189 N82-21782 #
DE82-001672 ..... p0189 N82-21783 #
DE82-001688 ..... p0189 N82-21781 #
DE82-001694 ..... p0294 N82-21725 #
DE82-001712 ..... p0223 N82-16532 #
DE82-001772 ..... p0224 N82-16929 #
DE82-001796 ..... p0235 N82-21748 #
DE82-001866 ..... p0234 N82-21736 #
DE82-001869 ..... p0283 N82-20685 #
DE82-001896 ..... p0171 N82-16510 #
DE82-001922 ..... p0234 N82-21735 #
DE82-001929 ..... p0263 N82-21436 #
DE82-001940 ..... p0264 N82-21694 #
DE82-001943 ..... p0253 N82-17574 #
DE82-001945 ..... p0294 N82-20687 #
DE82-001955 ..... p0276 N82-16901 #
DE82-001960 ..... p0172 N82-16559 #
DE82-001961 ..... p0223 N82-16528 #
DE82-001963 ..... p0172 N82-16523 #
DE82-001968 ..... p0253 N82-17575 #
DE82-001978 ..... p0235 N82-21737 #
DE82-002095 ..... p0281 N82-18706 #
DE82-002097 ..... p0234 N82-21729 #
DE82-002108 ..... p0285 N82-21732 #
DE82-002110 ..... p0227 N82-18703 #
DE82-002114 ..... p0291 N82-17635 #
DE82-002124 ..... p0187 N82-20476 #
DE82-002127 ..... p0261 N82-20697 #
DE82-002134 ..... p0264 N82-21693 #
DE82-002157 ..... p0234 N82-21734 #
DE82-002171 ..... p0287 N82-17448 #
DE82-002175 ..... p0176 N82-17407 #
DE82-002298 ..... p0251 N82-17400 #
DE82-002410 ..... p0263 N82-21429 #
DE82-002453 ..... p0259 N82-20335 #
DE82-002462 ..... p0285 N82-21759 #
DE82-002511 ..... p0249 N82-17317 #
DE82-002530 ..... p0263 N82-21437 #
DE82-002562 ..... p0260 N82-20474 #
DE82-002566 ..... p0186 N82-20277 #
DE82-002570 ..... p0263 N82-21435 #
DE82-002572 ..... p0250 N82-17399 #
DE82-002616 ..... p0263 N82-21430 #
DE82-002652 ..... p0258 N82-20279 #
DE82-002653 ..... p0260 N82-20695 #
DE82-002659 ..... p0258 N82-20283 #
DE82-002698 ..... p0235 N82-21751 #
DE82-002716 ..... p0262 N82-21283 #
DE82-002755 ..... p0235 N82-21750 #
DE82-002816 ..... p0232 N82-21225 #
DE82-002834 ..... p0259 N82-20332 #
DE82-002840 ..... p0234 N82-21731 #
DE82-002881 ..... p0260 N82-20336 #
DE82-002996 ..... p0188 N82-21728 #
DE82-003000 ..... p0236 N82-21762 #
DE82-003007 ..... p0285 N82-21722 #
DE82-003010 ..... p0177 N82-17634 #
DE82-003013 ..... p0260 N82-20492 #
DE82-003040 ..... p0251 N82-17507 #
DE82-003133 ..... p0261 N82-20698 #
DE82-003207 ..... p0285 N82-21723 #
DE82-003230 ..... p0285 N82-21756*#
DE82-003245 ..... p0260 N82-20696 #
DE82-003261 ..... p0260 N82-20680 #
DE82-003287 ..... p0187 N82-20679 #
DE82-003289 ..... p0236 N82-21752 #
DE82-003548 ..... p0186 N82-20475 #
DE82-003573 ..... p0283 N82-20688 #
DE82-003633 ..... p0236 N82-21755 #
DE82-003653 ..... p0250 N82-17339 #
DE82-003922 ..... p0235 N82-21745 #
DE82-003942 ..... p0264 N82-21810 #
DE82-004045 ..... p0233 N82-21721 #
DE82-004221 ..... p0246 N82-16275 #
DE82-004257 ..... p0262 N82-21282 #
DE82-004376 ..... p0233 N82-21443 #
DE82-004726 ..... p0232 N82-21441 #
DE82-004876 ..... p0249 N82-16673 #
DE82-900318 ..... p0248 N82-16519 #
DE82-900339 ..... p0294 N82-21763 #
DE82-900854 ..... p0187 N82-20699 #
DE82-900859 ..... p0173 N82-16568 #
DE82-900863 ..... p0251 N82-17508 #
DE82-900874 ..... p0233 N82-21727 #
DE82-900966 ..... p0189 N82-21786 #
DE82-901186 ..... p0291 N82-16526 #
DE82-901191 ..... p0225 N82-17628 #
DE82-0009555 ..... p0246 N82-16281 #

DNE-NE-249 ..... p0185 N82-20025 #

DOE/AF-92017/T1 ..... p0262 N82-21427 #
DOE/BP-53 ..... p0186 N82-20475 #
DOE/CS-20030/2 ..... p0187 N82-20679 #
DOE/CS-20232/1 ..... p0182 N82-18701 #
DOE/CS-20243/1 ..... p0172 N82-16537 #
DOE/CS-30171/3 ..... p0223 N82-16527 #
DOE/CS-30247/1 ..... p0227 N82-18703 #
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DOE/CS-31217/T7 ..... p0236 N82-21762 #
DOE/CS-50194/1 ..... p0184 N82-19542*#
DOE/CS-50194/1 ..... p0184 N82-19543*#
DOE/CS-50194/1 ..... p0184 N82-19544*#
DOE/CS-54209/4 ..... p0179 N82-18066*#
DOE/CS-54209/5 ..... p0292 N82-18067*#
DOE/CS-83004/1 ..... p0248 N82-16529 #
DOE/EIA-0214/79-S ..... p0188 N82-21728 #
DOE/EIA-11975/T1 ..... p0174 N82-16767 #
DOE/EP-10012/1 ..... p0173 N82-16565 #
DOE/ER-01084/T1 ..... p0276 N82-16525 #
DOE/ER-10000/T2 ..... p0225 N82-17633 #
DOE/ER-10510/T3 ..... p0262 N82-21283 #
DOE/ER-30008/T1 ..... p0234 N82-21730 #
DOE/ET-10152/T2 ..... p0250 N82-17399 #
DOE/ET-10415/T4 ..... p0244 N82-16211 #
DOE/ET-10460/16/17 ..... p0250 N82-17339 #
DOE/ET-10532/T2 ..... p0251 N82-17402 #
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DOE/ET-11314/T1 ..... p0249 N82-16560 #
DOE/ET-11338/T1 ..... p0259 N82-20334 #
DOE/ET-14292/T1 ..... p0261 N82-20697 #
DOE/ET-14303/T1 ..... p0250 N82-17395 #
DOE/ET-14700/7 ..... p0249 N82-17315 #
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DOE/ET-14803/T6 ..... p0249 N82-17314 #
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DOE/ET-14943/T1 ..... p0244 N82-16210 #
DOE/ET-15416/2-VOL-1 ..... p0280 N82-18704 #
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DOE/ET-15440/4 ..... p0285 N82-21732 #
DOE/ET-15450/T18 ..... p0251 N82-17400 #
DOE/ET-17089/T2 ..... p0281 N82-18706 #
DOE/ET-17091/T2 ..... p0188 N82-20700 #
DOE/ET-17091/T3 ..... p0264 N82-21780 #
DOE/ET-20279/T11 ..... p0232 N82-21442 #
DOE/ET-20279/108 ..... p0234 N82-21731 #
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STAR (N-10000 Series)	N82-22141 - N82-28242
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NASA SP-7043(35)

ENERGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

Issue 35

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between July 1 and September 30, 1982 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

NASA Scientific and Technical Information Branch 1982
National Aeronautics and Space Administration
Washington, DC

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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(35)) lists 881 reports, journal articles, and other documents announced between July 1, 1982 and September 30, 1982 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The entries are arranged in eight major categories, with *IAA Entries* preceding *STAR Entries* in each category. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

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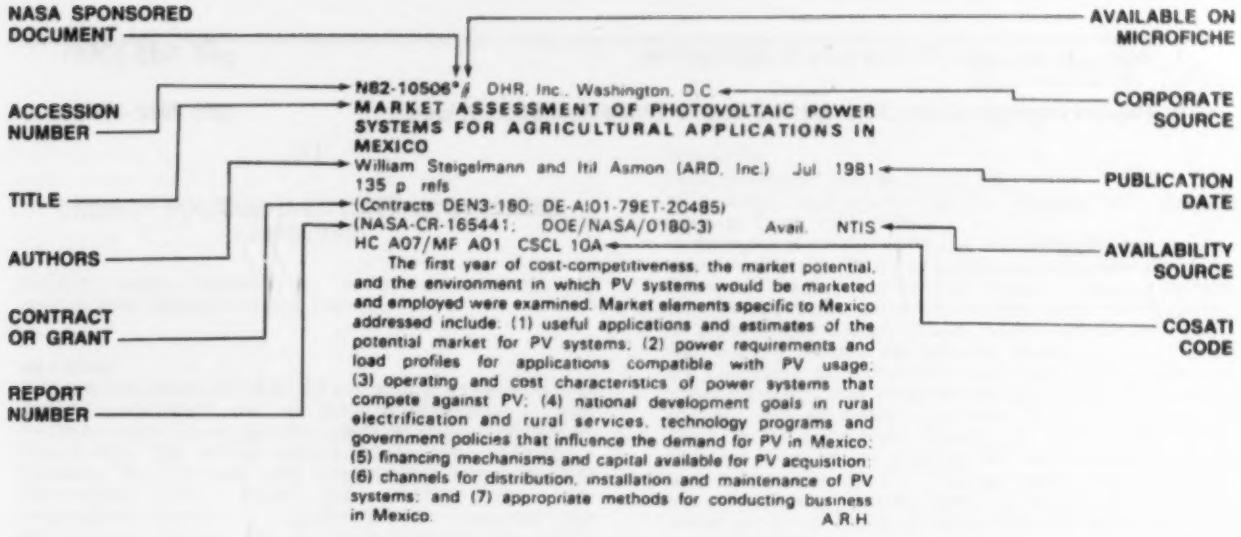

N82-10506*# DHR, Inc., Washington, D.C.

MARKET ASSESSMENT OF PHOTOVOLTAIC POWER SYSTEMS FOR AGRICULTURAL APPLICATIONS IN MEXICO

William Steigelmann and Itil Asmon (ARD, Inc.) Jul. 1981 135 p refs

(Contracts DEN3-180; DE-AI01-79ET-20485)

(NASA-CR-165441; DOE/NASA/0180-3) Avail. NTIS HC A07/MF A01 CSCL 10A

The first year of cost-competitiveness, the market potential, and the environment in which PV systems would be marketed and employed were examined. Market elements specific to Mexico addressed include: (1) useful applications and estimates of the potential market for PV systems; (2) power requirements and load profiles for applications compatible with PV usage; (3) operating and cost characteristics of power systems that compete against PV; (4) national development goals in rural electrification and rural services, technology programs and government policies that influence the demand for PV in Mexico; (5) financing mechanisms and capital available for PV acquisition; (6) channels for distribution, installation and maintenance of PV systems; and (7) appropriate methods for conducting business in Mexico.

A.R.H.

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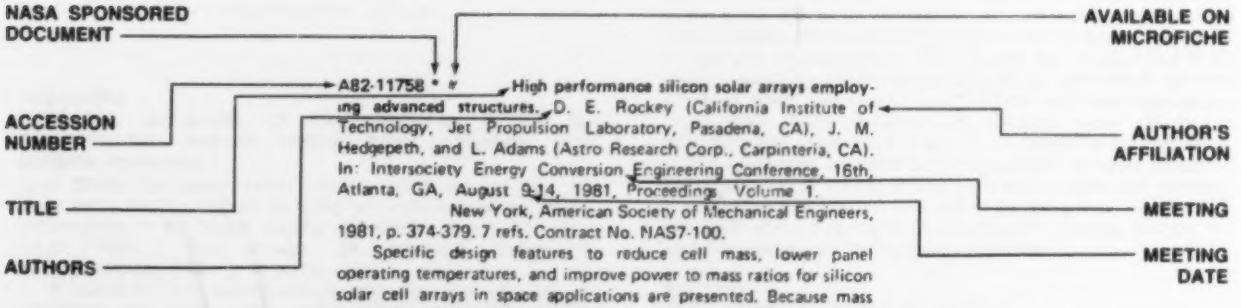

A82-11758 * # **High performance silicon solar arrays employing advanced structures.** D. E. Rockey (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), J. M. Hedgepeth, and L. Adams (Astro Research Corp., Carpinteria, CA). In: Intersociety Energy Conversion Engineering Conference, 16th, Atlanta, GA, August 9-14, 1981, Proceedings. Volume 1. New York, American Society of Mechanical Engineers, 1981, p. 374-379. 7 refs. Contract No. NAS7-100.

Specific design features to reduce cell mass, lower panel operating temperatures, and improve power to mass ratios for silicon solar cell arrays in space applications are presented. Because mass constraints limit payload capacity for launch into GEO, graphite/epoxy structures combined with high performance Si cells are needed to deliver a power/mass ratio of 265 W/kg, notably for Solar Electric Propulsion systems, compared with existing level of 65 W/kg. Shallow diffusion and back surface field cell technology have raised cell efficiencies to 15%, with a back emissivity of 1.64. Structural design requirements comprise Shuttle interface compatibility, full ground test capability, low mass, and high stiffness. Three array alternatives are discussed, and the STACBEAM configuration, which consists of a triangular truss and a piston deployer with folding accomplished on simple hinges, provides 0.2 Hz stiffness and achieves the design power/mass goals.

D.H.K.

A Listing of Energy Bibliographies Contained in This Publication:

1. Solar Energy Legal Bibliography second update p48 N82-23681
2. Review of physical and chemical methods for characterization of fuels p83 N82-26488

ENERGY

A Continuing Bibliography (Issue 35)

OCTOBER 1982

01

ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Includes energy requirements, energy conservation, and environmental impacts of energy systems.

A82-29425
THE SIGNIFICANCE OF COAL AND OTHER SOLID FUELS FOR THE REQUIREMENTS OF THE ENERGY ECONOMY. I - THE PRESENT AND FUTURE SIGNIFICANCE OF SOLID AND OTHER FUELS FOR THE WORLD AND PARTICULARLY WESTERN EUROPE [BEDEUTUNG DER STEINKOHLE UND ANDERER FESTBRENNSTOFFE FUER DIE VERSORGUNG DER ENERGIEWIRTSCHAFT. I - BISHERIGE UND ZUKUENFTIGE BEDEUTUNG FESTER UND ANDERER BRENNSTOFFE FUER DIE WELT UND INSBESONDERE WESTEUROPA]
R.-R. JAKISCH and C. HEMPEL (Ruhrkohle International GmbH, Essen, West Germany) Brennstoff-Waerme-Kraft, vol. 34, Mar. 1982, p. 105-116. In German.

The importance of various energy sources during the last few decades is discussed, and predictions are made for their importance in the eighties and nineties. Coal in the West European market is discussed in relation to other energy carriers with emphasis on the probable areas of demand in the years from 1980 to 2000. Effects of the 1973 oil crisis on the structure of the primary energy consumption up to 1980 are presented. It is predicted that by the year 2000, the world energy consumption of coal will climb to at least 4.4 billion tons of bituminous coal per year. D.L.G.

A82-29537#
SPECTRAL SCANNING OF EXPERIMENTAL PLOTS OF SO2-AFFECTED WINTER WHEAT AND SOYBEANS FOR MISSION PLANNING
C. D. SAPP (Tennessee Valley Authority, Chattanooga, TN) In: Color aerial photography in the plant sciences and related fields; Proceedings of the Eighth Biennial Workshop, Luray, VA, April 21-23, 1981. Falls Church, VA, American Society of Photogrammetry, 1981, p. 101-114. refs

A series of TVA experiments is described wherein plots of soybeans and winter wheat plants were grown to the critical seed-filling stage of development, exposed to controlled doses of SO2, observed systematically for foliar effects, then scanned row by row with a spectroradiometer. The spectral curves were statistically analyzed to determine the changes in spectral reflectance that occur after plants are stressed by SO2 emissions. For soybeans, the affected subplots had higher visible reflectance, lower IR reflectance, and a lower IR/red ratio. Variance analysis showed significant differences in IR and IR/red reflectance between chlorotic soybeans and unaffected ones; and in red reflectance, IR reflectance and IR/red ratio between necrotic and unaffected ones. Since the wheat subplots showed no chlorosis, analysis of reflectance data concentrates on necrosis, which showed a significant difference in red, IR, and IR/red reflectance between classes of differentially injured wheat. C.D.

A82-29774
FUEL EFFICIENT AND MACH 0.8, TOO
W. E. ARNDT (Lockheed-Georgia Co., Marietta, GA) Lockheed Horizons, Spring 1982, p. 26-34.

Principles of propfan technology and problems which must be solved for the introduction of propfans to production aircraft are discussed. The Hamilton-Standard concept, introduced in 1975, includes thin profile, swept-back multiple blades (8-10) suitable for cruise speeds of Mach 0.8 with 15-20% less fuel consumption than currently available with turbofans. Studies in loading fatigue are necessary to determine if the cyclic loading caused by high-speed swept back wings will adversely affect the integrity of composite-material propfans. Additional areas of concern are effects on the aerodynamic efficiency of aircraft induced by the presence of multibladed propfans, and the necessity of adding noise-reducing materials to maintain satisfactory cabin noise levels is a potential weight penalty factor. NASA trials on a converted Jetstar are described, along with possible techniques to reduce near- and farfield noise levels. M.S.K.

A82-32147
THE BR/CL RATIO IN ATMOSPHERIC AEROSOLS AS A TRACER OF AUTOMOBILE POLLUTION [LE RAPPORT BR/CL DANS L'AEROSOL ATMOSPHERIQUE COMME TRACEUR DE LA POLLUTION AUTOMOBILE]
C. ELICHEGARAY, R. VIE LE SAGE, B. GRUBIS, and J. L. COLIN (Paris VII, Universite, Paris, France) Pollution Atmospherique, vol. 24, Jan.-Mar. 1982, p. 37-41. In French. refs

The use of antiknock additives in automotive fuels has been found to cause an increase in exhaust emissions of chlorine and bromine as well as lead. The present paper examines the potential of the Br/Cl ratio as an indicator of the contribution of automobiles to atmospheric chlorine levels. Review of the atmospheric chemistry of aerosols of automotive origin reveals the value of the Br/Cl ratio to reflect the relative proportions of the elements in gasoline additives, which range from 0 to 2.25. These values are significantly more than those expected in aerosols from natural or nonautomotive anthropogenic sources. A means for the calculation of the automobile contribution to atmospheric aerosols based on the assumption of the maximum Br/Cl ratio in automotive exhausts is presented and applied to a set of sampling data acquired for Paris, for which it is found that automotive sources account for about 14 percent of the particulate chlorine. A.L.W.

A82-33250
PRINCIPLES OF EFFICIENT ENERGY USE AT INTERFLUG [GRUNDSAETZE DER RATIONELLEN ENERGIEANWENDUNG BEI DER INTERFLUG]
K. HENKES (Ministerium fuer Verkehrswesen; Gesellschaft fuer Internationalen Flugverkehr mbH, Berlin, East Germany) Technisch-oekonomische Information der zivilen Luftfahrt, vol. 17, no. 5-6, 1981, p. 214-220. In German.

Attention is given to the problems of efficient energy use in civil aviation, taking into account conditions in the German Democratic Republic and its Interflug airline. It is pointed out that 98% of the energy requirements of Interflug are met with the aid of energy carriers produced from petroleum. These energy carriers are almost exclusively aircraft fuels, and 50% of the fuel is obtained in refueling operations conducted in foreign countries. Interflug has, therefore, been concerned with the implementation of

approaches for reducing the performance-related fuel consumption for its aircraft. A reduction in performance-related fuel consumption of 10-16% for each aircraft type could be achieved. This reduction is partly the result of organizational steps leading to a more efficient utilization of the aircraft, and partly the result of a number of suitable technical-technological procedures. Plans are discussed for a further reduction of the requirements for fuel and electric power by a variety of different approaches. G.R.

A82-33407
DUST-EMISSION MEASUREMENTS IN TWO POWER PLANTS [STAUB-EMISSIONS-MESSUNGEN IN ZWEI KRAFTWERKEN]
H. SCHNITZLER Staub - Reinhaltung der Luft, vol. 42, Jan. 1982, p. 15-21. In German. Research supported by the Bundesministerium des Innern. refs

Various emission measuring instruments for continuous and quasi-continuous recording of the dust concentration in waste gases were tested in coal-fired and oil-fired power plants. New methods of the acquisition, processing, and evaluation of measured values are described. The average dust concentration in waste gases amounted to 100-135 mg/cu m in the coal-fired plant and about 14 mg/cu m in the oil-fired plant, based on standard conditions. Examples are given of dust emission controls of several days' duration. C.D.

A82-34113#
SOLUTIONS TO THE AVIATION FUEL PROBLEM
W. M. HAWKINS (Lockheed Aircraft Corp., Burbank, CA) In: International aerospace review; Proceedings of the First International Aerospace Symposium, Le Bourget, Seine-Saint-Denis, France, June 2, 3, 1981. New York, American Institute of Aeronautics and Astronautics, 1982, p. 165-180.

Projections of the duration of availability of petroleum-derived jet fuels are reviewed and candidates for alternative fuels are discussed. World production of crude oil is expected to begin to irreversibly decline in the 1990s, and the design of new aircraft which could use alternative fuels is noted to depend strongly on the new fuels which have yet to be chosen. Any new fuel supply will be required to have a low producibility cost, be continuously replenishable, be available for multiple uses, be easy to handle and transport, safe to use, cause no major changes in equipment, and be minimally polluting. An additional consideration is that the fuel could be derived where used to avoid the political problems inherent in current fuel supplies. Liquid hydrogen is found to be the best solution because of light weight, water as the source, available everywhere, and costs less than shale or coal-derived fuels. M.S.K.

A82-34119#
SPACE AND ENERGY - A GLOBAL VIEWPOINT
D. E. KOELLE (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) In: International aerospace review; Proceedings of the First International Aerospace Symposium, Le Bourget, Seine-Saint-Denis, France, June 2, 3, 1981. New York, American Institute of Aeronautics and Astronautics, 1982, p. 249-260. refs

Possible contributions by organizations involved with space technology to the alleviation of a projected catastrophic world energy crisis which may begin around the year 2000 are discussed. Space disposal of long-lived radionuclides from burnt-out reactor rods is suggested as a viable means to reducing the time required for the remaining fission products which would be geologically imbedded to decay to background levels in 20 yr. An additional cost to consumers of 0.1 cent/kWh is projected using a ballistic missile to remove all the high level wastes from the U.S. and European nuclear power plants. Satellite solar power systems are calculated to depend on a reduction in cost/kWh from 20-50 dollars to 0.50 cents and two orders of magnitude in transportation to attain economic viability. M.S.K.

A82-34980#
ENERGY EFFICIENT ENGINE /E3/ TECHNOLOGY STATUS
W. B. GARDNER (United Technologies Corp., Commercial Products Div., East Hartford, CT) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 10 p. refs
(AIAA PAPER 82-1052)

The Energy Efficient Engine (EEE) Technology program has the objective to establish the technology readiness of components and subsystems which could be utilized in turbofan engines in the late 1980's, early 1990's. A description is presented of the results of the supporting technology programs, the status and results of the component verification testing to date, and the possibilities for employing the developed technology in connection with the design of an energy efficient, environmentally acceptable engine for the 1990's. Attention is given to aspects of shroudless fan fabrication, the diffuser/combustor model, a combustor sector rig, an uncooled high-pressure turbine rig, supersonic high-pressure turbine cascades, a high-pressure turbine cooling model, aspects of high-pressure turbine leakage control, and subsonic cascades. G.R.

A82-35235
THE VALUE OF SEASONAL CLIMATE FORECASTS IN MANAGING ENERGY RESOURCES
E. B. WEISS (Georgetown University, Washington, DC) Journal of Applied Meteorology, vol. 21, Apr. 1982, p. 510-517. NSF-supported research. refs

A82-35479#
TECHNOLOGY ADVANCEMENTS FOR ENERGY EFFICIENT AIRCRAFT ENGINES
R. W. BUCY (General Electric Co., Cincinnati, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 9 p. refs
(AIAA PAPER 82-1051)

The rapid increase in fuel costs since 1973 has been a major influence on the economics of the commercial aircraft fleet. The development of more fuel efficient aircraft engines has, therefore, become an important priority for aircraft engine manufacturers and NASA. Major goals of a program designed to achieve better fuel efficiency include, relative to the CF6-50C reference engine, 12% reduction in installed Specific Fuel Consumption (SFC), 5% reduction in Direct Operating Costs (DOC), and 50% reduction in the SFC deterioration rate in commercial service. A description is presented of the progress made, in connection with the considered program, over the past four and one-half years. Attention is given to component and engine development tests, the fan component test, high pressure compressor component tests, combustor component tests, high and low pressure turbine component tests, and overall systems integration. G.R.

A82-35881
PROPELLERS COME FULL CIRCLE
R. DEMEIS High Technology, vol. 2, July-Aug. 1982, p. 16-18.

The use of the propfan in future aircraft is discussed. With the large external fan generating more thrust per engine revolution than a small internal fan, propfan jets could achieve fuel savings as high as 25 percent in commercial operations and 35 percent for military patrol missions, while retaining the vibration-free operation and mechanical simplicity of turbojet engine cores. The propfan would have as many as 12 stiff composite blades that would be highly swept, thinner, and shorter than conventional blades in order to reduce noise and drag. The gearbox would be reintroduced to permit operation at maximum efficiency with the best blade rotation speed for the airflow conditions. A double-wall insulated fuselage and shaped wing-nacelle interface would deal with internal aircraft noise and propfan-swept wing integration problems. The development of the propfan may depend on continued government funding to NASA's program. C.D.

A82-36291* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOURCES OF ATMOSPHERIC AMMONIA
R. C. HARRISS and J. T. MICHAELS (NASA, Langley Research Center, Hampton, VA) American Meteorological Society, American Geophysical Union, and NASA, Symposium on the Composition of the Nonurban Troposphere, 2nd, Williamsburg, VA, May 25-28, 1982, Paper. 3 p. refs

The information available on factors that influence emissions from the principal societal sources of ammonia to the atmosphere, namely combustion processes, volatilization of farm animal wastes, and volatilization of fertilizers, is reviewed. Emission factors are established for each major source of atmospheric ammonia. The factors are then multiplied by appropriate source characterization descriptors to obtain calculated fluxes of ammonia to the atmosphere on a state-by-state basis for the United States. C.R.

A82-36752
A REVIEW OF UNITED KINGDOM WINDPOWER
M. N. MILLAR (Napier College of Commerce and Technology, Edinburgh, Scotland) International Journal of Ambient Energy, vol. 3, Jan. 1982, p. 35-46

A historical review and an assessment of current U.K. wind energy installations and plans are presented. A 100 kW wind turbine was erected in 1951 in Scotland and operated into the late 1950's. Another machine, the Enfield-Andreau 100 kW machine was built and tested at St. Albans in 1955. It featured hollow blades with airholes which created a pneumatic force for driving a generator located in the tower base. Finally, a 100 kW unit was established on the Isle of Man in 1960. A 22 kW Danish turbine has recently been installed on South Ronaldson Island and serves to create experience with grid interconnected WECS. The British government is constructing a 250 kW prototype and model for a 3 MW, dual-blade, upwind WECS with a 151 ft hub height. Research is continuing on a 130 kW Musgrove VAWT with variable geometry. A total of 21 experimental machines existed in the U.K. in 1981. M.S.K.

A82-37065#
A SIGNIFICANT ROLE FOR COMPOSITES IN ENERGY-EFFICIENT AIRCRAFT
G. A. ALTHER (Composite Aircraft Corp., Midland, TX) In: Reinforced Plastics/Composites Institute, Annual Conference, 36th, Washington, DC, February 16-20, 1981, Preprints. New York, Society of the Plastics Industry, Inc., 1981 (Session 12-D). 4 p. refs

The structural advantages and a 10-year in-service history of the Windecker Eagle all fiberglass/epoxy airframes are discussed. In these airframes, the skins are composed of one or more plies of nonwoven unidirectional fiber cloth, the wing spars and other laminates are also composed of multiple oriented plies of fiber cloth, and a ply of nonwoven 0/90 cloth is used for the outermost plies of the laminates and skins to enhance the finish. Stiffening for the skin laminates is provided by composite laminate stringers varying in thickness from 1/4 to 1 inch spaced with polyurethane foam. The fuselage is molded in one-piece halves complete with vertical tail, wing root, and stabilizer junctures, and bonded together at mating flanges along the top and bottom body lines. It is shown that apart from aerodynamics and energy efficiency, the all fiberglass/epoxy airframe provides greater strength, toughness, and redundancy compared to aluminum for equivalent structural weight. V.L.

N82-22276# Rolls-Royce Ltd., Derby (England).
FUEL EFFICIENCY ENGINES FOR LARGE TRANSPORT AIRCRAFT
D. J. PARFITT 27 Mar. 1981 27 p Presented at Aeron. Soc. of India Conf., Bombay, 27 Mar. 1981
(PNR-90082; MISC-555) Avail: NTIS HC A03/MF A01

The next generation of Rolls Royce aircraft engines is discussed, especially their fuel consumption. For the RB211, improvements on the order of 15% in fuel consumption relative to the initial service standard are planned. Large fan engines are expected to remain technology leaders in the long-term. Fuel savings on the order of 10% to 15% are feasible, using low specific thrust designs. Noise and exhaust emission improvements are predicted. Advanced wing designs and the use of lightweight composite materials, linked with full authority digital control systems, enhance engine performance. Liquid hydrogen is suggested as a replacement for kerosene, because of its high heating value. Author (ESA)

N82-22393# International Business Services, Inc., Washington, D.C.
INVESTIGATING THE RELATIONSHIP BETWEEN LAND USE PLANNING, TRANSPORTATION AND ENERGY CONSUMPTION Final Report
B. BURGWALD, W. COLE, and C. WAGNER Jan. 1981 143 p refs
(Contract DTOS59-80-C-0060)
(PB82-122185; DOT/P-10-81/90) Avail: NTIS HC A07/MF A01 CSCL 13B

The relationship among land use, transportation accessibility and energy consumption in and urban context was investigated. The issues addressed include: (1) how transportation accessibility and land use planning interact for increased energy conservation; (2) the role the public sector plays with regard to incorporating and integrating transportation, land use and energy conservation; and (3) the institutional and/or technical barriers for better integration of energy, transportation and land use considerations. GRA

N82-22464# Gordian Associates, Inc., Washington, D. C.
HEAT PUMP DEMAND CHARACTERISTICS: A STUDY OF THE IMPACTS OF SINGLE-FAMILY RESIDENTIAL HEAT-PUMP TECHNOLOGIES ON ELECTRIC-UTILITY-SYSTEM LOADS Final Report
A. LANNUS, M. HESSE, and B. APPELBAUM Oct. 1981 145 p refs Sponsored by EPRI
(Contract EPRI PROJ. 1100-1)
(DE82-900861; EPRI-EA-2074) Avail: NTIS HC A07/MF A01

The hourly power demand and heating- and cooling-mode energy use of electric air source heat pumps in single-family residences was analyzed and correlated. Field data from 50 houses in five different geographical locations, representing a range of 1434 to 8310 heating degree days and 2889 to 527 cooling degree days, were selected from a previous field study. A subset of the data was used to test a residential building-heat pump simulation model. Calculated daily heating energy consumption agreed to within 10 to 27% of the measured values; daily cooling energy consumption agreed to within 12 to 23% of the measured values. A Monte Carlo simulation procedure was developed for the prediction of heat pump diversified demand based on a probability sample of residential customers selected on the basis of certain customer-class, equipment, and weather-related characteristics. Due to lack of valid field data, only a crude test of this procedure was possible, but it indicated that this method holds promise in simulations where test metering data are unavailable. DOE

N82-22537# Comptroller General of the United States, Washington, D.C.
STRATEGIC PETROLEUM RESERVE: SUBSTANTIAL PROGRESS MADE, BUT CAPACITY AND OIL QUALITY CONCERNS REMAIN Report to the Congress
31 Dec. 1981 63 p refs
(EMD-82-19; B-203117) Avail: SOD

During fiscal year 1981, the Government filled the Strategic Petroleum Reserve at an average rate of 292,000 barrels per day, the highest rate achieved for any fiscal year since oil fill began. Efforts since July 1980 to fill the reserve are discussed and it is noted that the Department of Energy will be able to maintain only an average rate of 189,000 barrels per day from fiscal year 1982 to 1989 under current expansion plans. Recommendations concerning the availability of storage capacity and the quality of oil stored in the reserve are given. T.M.

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

N82-22585*# Aerial Information Systems, Crestline, Calif.
APPROPRIATENESS IN USING LANDSAT IN DEVELOPMENT ENERGY RELATED DATA BASES
E. HARNDEN *In* NASA. Ames Research Center Western Reg. Remote Sensing Conf. Proc., 1981 p 205-209 Sep. 1981
ERTS
Avail: NTIS HC A12/MF A01 CSCL 05B

The use of automated classification systems in the field of resource management and resource inventory is discussed. Applications of LANDSAT classification are outlined and include: energy load forecasting based upon land use inventories and change analysis, impact analysis of activities related to energy extraction, capability/suitability mapping in support of generation and substation location and transmission line routing, and assessment of solar energy potential in a highly urbanized setting where land values are high. It is found that the use of LANDSAT data is adequate for general inventories where few data categories are required, where resolution of data to around 150 acres minimum is required, and where no other complete imagery set can be obtained. T.M.

N82-22637# Bergbau-Forschung G.m.b.H., Essen (West Germany).
TIMESAVING METHODS ADAPTABLE TO MINING WHICH UTILIZE STRUCTURAL INFORMATION ON THE FOREFIELD WHILE APPLYING NEW TECHNOLOGIES Final Report, Jun. 1980
H. MURAWSKI and K. H. RUELLER Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 125 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-220; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 26,45

Fabric data for diagnosis of tectonics in a coal mine was studied. The possibility of combining geophysics, well logging, and structural surveys in forefield research was investigated in the Ruhr district. Subterranean outcroppings in mines were studied. Planes of cleavage, systems of cleats, and genesis of cleats were measured photometrically. A data reduction and display program, PLANICOMP, was improved, and electronic data processing was used to find Braun's index. A tectonic deformation index and basic structure are determined. The system provides sufficient information on the tectonic situation in the forefield and is a practicable aid to the miner. Author (ESA)

N82-22639# New England River Basins Commission, Boston, Mass.
PENOBSCOT RIVER BASIN OVERVIEW
Sep. 1981 152 p refs Sponsored in part by Water Resources Council
(PB82-131467) Avail: NTIS HC A08/MF A01 CSCL 13B

Water resources issues identified in the Penobscot River basin are discussed and concern hydropower development, minerals development, forestry, and acid rain. Other water resource problems in the basin, principally related to the urban centers in the southern portion, include point source wastewater discharges, water supply needs, some flooding, and access to water-related recreation. GRA

N82-22640# New England River Basins Commission, Boston, Mass.
ST. CROIX/MAINE EASTERN COASTAL RIVER BASINS OVERVIEW: PUBLIC REVIEW DRAFT
Sep. 1981 161 p refs Sponsored in part by Water Resources Council
(PB82-133091) Avail: NTIS HC A08/MF A01 CSCL 13B

Issues identified in the St. Croix/Maine Eastern Coastal River basins center on proposals for major energy facilities in Cobscook Bay, forestry, acid rain, potential flooding and sometime conflicting uses of the rivers. International concerns are addressed. GRA

N82-22647# Comptroller General of the United States, Washington, D.C.
GREATER ENERGY EFFICIENCY CAN BE ACHIEVED THROUGH LAND USE MANAGEMENT Report to the Congress
21 Dec. 1981 58 p refs
(EMD-82-1; B-198982) Avail: SOD

An analysis of energy conservation methods based on land use management is given and recommendations are made. When planning new growth and redevelopment, communities can significantly reduce energy consumption by incorporating energy efficient land use concepts such as site and building design, locational planning, and higher density development. Decisionmakers, however, are reluctant to use these concepts because of major barriers such as the cost of implementing the concepts and resistance to higher density development. The Federal Government can play a role in promoting energy-efficient land use by providing guidance through its policies, supporting research and comprehensive planning, and providing needed financial incentives. R.J.F.

N82-22648 International Institute for Applied Systems Analysis, Laxenburg (Austria).
THE POSSIBLE SHARE OF SOFT/DECENTRALIZED RENEWABLES IN MEETING THE FUTURE ENERGY DEMANDS OF DEVELOPING REGIONS
A. M. KHAN Sep. 1981 41 p refs
(RR-81-18; ISBN-3-7045-0015-1) Avail: Issuing Activity

The contribution of soft/decentralized renewables to energy supply in market economy developing regions is discussed. Investment requirements and fuel production costs are compared with conventional supply schemes. Difficulties associated with these technologies are analyzed. The most promising soft/decentralized renewables are: windmills and small hydropower units for use in irrigation and for supplying electricity to rural households and small towns; charcoal for meeting thermal energy requirements of industry, households, and the service sector; biogas for use in rural households; and solar heat for supplying hot water/steam to industry, households, and services. Author (ESA)

N82-22667# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
UTILITY SITING OF WECS: A PRELIMINARY LEGAL/REGULATORY ASSESSMENT
R. J. NOUN, M. LOTKER (Synectics Group, Inc.), and H. P. FRIESEMAN (Inst. of Ecology) May 1981 103 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-744-778) Avail: NTIS HC A06/MF A01

The early experiences of several utilities in dealing with the legal and regulatory issues that were raised in the process of siting wing energy installations were examined. Recommendations are made as to how utilities can begin to address many of the identified issues. Two issues associated with utility siting of wind machines are cited: (1) land acquisition and use and (2) aesthetic controls. Land use control regulations dealing with incompatible uses, nuisance factors, building scale limitations, and on site environmental impacts many constrain wind machine siting by utilities. The siting issue of greatest concern is how the public will react to the hard reality of wind power development. Little public opposition to wind energy projects is raised to date, yet it is possible that local attitudes will change as the novelty of the early single unit machines wears off. It is concluded that potentially adverse impacts based on local aesthetic concerns can be minimized by careful planning, siting, and design by utility developers and by close coordination with local planning and regulatory officials. E.A.K.

N82-22678*# Argonne National Lab., Ill.
ENVIRONMENTAL ASSESSMENT OVERVIEW
A. R. VALENTINO *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 37-53 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

The assessment program has as its objectives: to identify the environmental issues associated with the SPS Reference System;

to prepare a preliminary assessment based on existing data; to suggest mitigating strategies and provide environmental data and guidance to other components of the program as required; and to plan long-range research to reduce the uncertainty in the preliminary assessment. The key environmental issues associated with the satellite power system are discussed and include human health and safety, ecosystems, climate, and interaction with electromagnetic systems. T.M.

N82-22679*# PRC Systems Sciences Co., Los Angeles, Calif.
SOCIETAL ASSESSMENT OVERVIEW
C. E. BLOOMQUIST *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 54-77 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

The decision to proceed with SPS depends on a political determination that commitment of the economic, institutional, and social energies required for its implementation is a worthwhile investment. This determination is national (and international) in scope and is based on knowledge of the environmental and societal impacts of the SPS, its projected economics and technological risks, expressed through the influence of contending segments of society. To assist the decision makers, an assessment of societal issues associated with the SPS was undertaken as part of the Concept Development and Evaluation Program. Results of the assessment are reported. The primary societal assessment objectives are to determine if the societal ramifications of an SPS might significantly impede its development, and to establish an information base regarding these issues. Estimates regarding SPS impacts commensurate with its stage of development and the needs of the decision makers are provided. T.M.

N82-22680*# European Space Research and Technology Center, Noordwijk (Netherlands).
AN OVERVIEW ON EUROPEAN SPS ACTIVITIES
K. K. REINHARTZ *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 78-87 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

The organization of space and energy research in Europe is discussed. The European situation is highlighted with emphasis on the dependency of energy imports and on the energy requirements of Europe. The status of SPS research in the countries that form the European Space Agency was reviewed. It is concluded that in view of the unfavorable geographical and climatic situation of large parts of Europe, terrestrial solar energy conversion is unlikely to make a significant contribution to Europe's future energy supply. Thus, SPS development is of special interest to the European community. T.M.

N82-22688*# Argonne National Lab., Ill.
OVERVIEW OF ATMOSPHERIC EFFECTS
D. M. ROTE *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 113-115 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Effluents from the transportation system are the major cause of Satellite Power System related atmospheric effects. These effects are discussed and include inadvertent weather modification, air quality degradation, compositional changes in the stratosphere and mesosphere, formation of noctilucent clouds, plasma density changes, airglow enhancements, and changes in composition and dynamics of the plasmasphere and magnetosphere. L.F.M.

N82-22689*# Institute for Telecommunication Sciences, Boulder, Colo.
IONOSPHERIC DISTURBANCE OVERVIEW
C. M. RUSH *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 116-119 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

A program of research and exploratory development was undertaken to assess the potential impact of Satellite Power System operation on the ionosphere. The program relies on the utilization of ground-based ionospheric heating facilities in order to simulate the ionospheric heating that will come from the Satellite Power System. Thus far, the experimental program directed toward assessing telecommunications impacts has received the most attention, and little impact was observed on VLF, LF, and MF operations. L.F.M.

N82-22690*# Pacific Northwest Lab., Richland, Wash.
ELECTROMAGNETIC COMPATIBILITY OVERVIEW
K. C. DAVIS *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 120-121 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

An assessment of the electromagnetic compatibility impact of the Satellite Power System is discussed. The discussion is divided into two parts: determination of the emission expected from SPS including their spatial and spectral distributions, and evaluation of the impact of such emissions on electromagnetic systems including considerations of means for mitigating effects. L.F.M.

N82-22691*# California Univ., Berkeley. Lawrence Berkeley Lab.
NONMICROWAVE HEALTH AND ECOLOGICAL EFFECTS: OVERVIEW
M. R. WHITE *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 122-123 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

The potential environmental impacts due to the operation and construction of the Satellite Power System are discussed. The nonmicrowave health and ecological effects encompass impacts on the public, the terrestrial worker, the space worker, the ecology, and agriculture. L.F.M.

N82-22692*# Environmental Protection Agency, Research Triangle Park, N.C. Experimental Biology Div.
SPS MICROWAVE HEALTH AND ECOLOGICAL EFFECTS: PROGRAM AREA OVERVIEW
D. F. CAHILL *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 124 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

The potential microwave health and ecological effects due to the operations of the Satellite Power System are discussed. An outline of the research needed to insure public acceptance of the program is presented. L.F.M.

N82-22693*# PRC Energy Analysis Co., Los Angeles, Calif.
AN EVALUATION OF THE LAND AND MATERIAL REQUIREMENTS FOR THE SATELLITE POWER SYSTEM
S. D. ANKERBRANDT *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 125-128 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Current research and evaluation of the physical resources requirements for the Satellite Power System (SPS) concentrates on three topics: land requirements and the siting of rectennas; the environmental impacts of the rectenna siting; and the materials requirements. The first two focus exclusively on the Earth based element of the SPS while the materials assessment considered requirements for both the space and Earth systems. L.F.M.

N82-22696*# Argonne National Lab., Ill.
COMPARATIVE HEALTH AND SAFETY ASSESSMENT OF THE SPS AND ALTERNATIVE ELECTRICAL GENERATION SYSTEMS
L. J. HABEGGER, J. R. GASPER, and C. D. BROWN *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 150-153 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

A comparative analysis of health and safety risks is presented for the Satellite Power System and five alternative baseload electrical generation systems: a low-Btu coal gasification system with an open-cycle gas turbine combined with a steam topping cycle; a light water fission reactor system without fuel reprocessing; a liquid metal fast breeder fission reactor system; a central station terrestrial photovoltaic system; and a first generation fusion system with magnetic confinement. For comparison, risk from a decentralized roof-top photovoltaic system with battery storage is

also evaluated. Quantified estimates of public and occupational risks within ranges of uncertainty were developed for each phase of the energy system. The potential significance of related major health and safety issues that remain unquantitied are also discussed. M.D.K.

N82-22716*# Power Conversion Technology, Inc., San Diego, Calif.
COMPARISON OF LOW EARTH ORBIT AND GEOSYNCHRONOUS EARTH ORBITS
J. E. DRUMMOND *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 234-236 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

The technological, environmental, social, and political ramifications of low Earth orbits as compared to geosynchronous Earth orbits for the solar power satellite (SPS) are assessed. The capital cost of the transmitting facilities is dependent on the areas of the antenna and rectenna relative to the requirement of high efficiency power transmission. The salient features of a low orbit Earth orbits are discussed in terms of cost reduction efforts. E.A.K.

N82-22754*# Argonne National Lab., Ill. Energy and Environmental Systems Div.
RECTENNA RELATED ATMOSPHERIC EFFECTS
J. LEE *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 440-443 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

Possible meteorological effects arising from the existence and operations of a solar power satellite (SPS) system rectenna are examined. Analysis and model simulations in some chosen site situations and meteorological conditions indicate that the meteorological effects of the construction and operation of a rectenna are small, particularly outside the boundary of the structure. From weather and climate points of view, installation of an SPS rectenna seems likely to have effects comparable with those due to other nonindustrial land use changes covering the same area. The absorption and scattering of microwave radiation in the troposphere would have negligible atmospheric effects. M.G.

N82-22769# Department of Energy, Washington, D. C. Office of Environmental Assessments.
COAL-FIRED POWER PLANT (WESTERN COAL): ENVIRONMENTAL CHARACTERIZATION INFORMATION REPORT
Jan. 1981 67 p refs Prepared in cooperation with Aerospace Corp., Germantown, Md.
(Contract DE-A703-76EV-74010)
(DOE/EP-0019) Avail: NTIS HC A04/MF A01

The latest available environmental and technical information on coal-fired power plants was collected from a number of sources. The typical plant chosen for characterization was a 500/MWe pulverized-coal plant burning western low-sulfur coal. The plant uses an electrostatic precipitator, a lime/limestone scrubber, and a wet, mechanical draft cooling tower. The plant fuel is supplied from offsite mines by unit-train deliveries with surface mined, thick seam coal, which undergoes minimum preparation prior to pulverization. The process, plant operating parameters, resources needed, and environmental residuals and products associated with the power plant are presented. Annual resource usage and pollutant discharges are given, assuming an annual plant capacity factor of 80 percent. Quantities are given in terms of ten to the twelth power Btu's of electric energy produced. Several plants are discussed individually. Environmental regulations are discussed. The overall physical requirements of the plant for land and water are discussed. R.J.F.

N82-22771# National Building Research Inst., Pretoria (South Africa).
ENERGY CONSERVATION IN HOUSES. A TECHNICAL PRESS DAY REPORT ON THE RESULTS OF THE LOW ENERGY EXPERIMENTAL HOUSE PROJECT IN GARSFONTEIN, PRETORIA
7 Jul. 1981 14 p refs
Avail: NTIS HC A02/MF A01

The low energy experimental house project demonstrated that a home constructed from traditional materials, by traditional methods, maintains an acceptable indoor thermal environment with low levels of energy utilization, and evaluated the long term cost benefits of different energy saving options. Both the experimental and the demonstration aspects necessitated the use of full scale houses. Two such houses were built in Pretoria, one of which was to serve as a control. They were both typical well designed middle income homes, but the low energy house embodied a number of energy saving design features as well as an air based space and water heating solar system. The floor plans of both houses were similar and that of the low energy house is presented. S.L.

N82-22772# Joint Economic Committee (U. S. Congress).
A NATIONAL INDEX FOR ENERGY PRODUCTIVITY
A. PENZ and D. BAKKE Washington GPO 1981 46 p refs Rept. presented to the Joint Econ. Comm., 97th Congr., 1st Sess., 13 May 1981 Prepared by Mellon Inst., Arlington, Va.
(GPO-75-886) Avail: SOD HC

Possible indices to measure changes in energy productivity are explored. These indices could provide the nation with better information about how it uses energy. It is recommended that certain uses of these indices be adopted and widely disseminated by government. The widespread use of an energy productivity index by the government and in the media could provide many significant benefits: (1) it signals the importance that government attaches to increasing energy efficiency; (2) it focuses and sustains national attention on this critical energy strategy; (3) an energy productivity index motivates and challenges the nation; (4) it serves as an early warning system that current approaches are not working and new approaches are called for: (5) it is a useful tool for public planners and policy makers in predicting future energy productivity trends; and (6) energy productivity indices increase the publics understanding of energy services. It is concluded that the adoption of a systematic dissemination of the indices will enhance public understanding of energy productivity and contribute to maximizing energy efficiency. E.A.K.

N82-22781# Rocket Research Corp., Redmond, Wash.
UTILIZATION OF WASTE HEAT FROM MAJOR TRANSFORMER SUBSTATIONS. VOLUME 3: APPENDIX Final Report
N. T. CHRISTENSEN, K. W. ARASIM, C. R. ROBERTS, G. V. GIBNEY, and W. PRICE Aug. 1981 152 p refs Sponsored by EPRI Prepared in cooperation with Seattle City Light and Henningson, Durham and Richardson, P.S.
(Contract EPRI PROJ. 1274-1)
(DE82-900357; EPRI-EM-1968-VOL-3) Avail: NTIS HC A08/MF A01

Large substation transformers reject substantial thermal energy. Since these units are usually close-coupled to facilities requiring low-temperature thermal energy for space conditioning, the ability to recover and efficiently utilize this energy is of significant interest. A general system was designed and optimized for the recovery of transformer waste heat. Simplified analytical techniques were developed to assist utilities in both preliminary analysis and detail design analysis of specific systems, including system economics. Critical component performance parameters were identified for the preparation of detailed specifications. Criteria for the specific application of such systems through system economics are presented. T.M.

N82-22790# General Energy Associates, Cherry Hill, N.J.
NEW YORK STATE INDUSTRIAL ENERGY PROFILE, VOLUME 1 Final Report
B. B. HAMEL and B. L. BROWN Apr. 1981 250 p
(PB82-126848; REPT-49/EU-IUU/79-1-VOL-1; NYSERDA-81-9-1-VOL-1) Avail: NTIS HC A11/MF A01 CSCL 10A

A New York State industrial energy data base compatible with the national data base which includes industrial energy use on a national level and energy recovery technologies was studied. The data base is a comprehensive New York industrial energy use profile by county and 4 digit standard industrial classification (SIC) and includes the following process and waste energy fuel type, plant size, and employee distribution. Total energy consumption in the manufacturing sector in New York State. GRA

N82-22791# California Energy Commission, Sacramento.
ELECTRICITY TOMMORROW Final Report
Jan. 1981 490 p
(PB82-124165; CAEC-81) Avail: NTIS HC A21/MF A01 CSCL 10A

The critical issues for the electricity sector in California were presented. Adopted level of electricity demand and adopted policies and supply criteria are included. These form the basis for planning and certification of electric generation and transmission facilities by the energy commission. Estimates of the potential contributions of conservation and various conventional and alternative supply sources, critiques of utility supply plans, and determinations of how much new capacity is required are also included. Policy recommendations for directing public and private investments into preferred energy options, for spreading the benefits and costs of these options broadly and fairly among California's citizens, and for removing remaining obstacles to the development of all acceptable energy sources are presented. GRA

N82-22792# Minnesota Energy Agency, St. Paul.
THE POTENTIAL FOR UTILITY CONSERVATION INVESTMENTS IN MINNESOTA
Jan. 1981 285 p
(PB82-122219; MEA-1-81) Avail: NTIS HC A13/MF A01 CSCL 10A

The need for utility investments in conservation is analyzed. A framework for carrying out such an analysis, and goals for a conservation program are developed. Issues which stand in the way of achieving those goals are examined. The desirability of alternative utility conservation strategies is assessed. Policy recommendations are made for the Minnesota public utilities commission to consider in establishing a utility conservation investment pilot program. GRA

N82-22793# National Materials Advisory Board, Washington, D. C. Commission on Sociotechnical Systems.
AN ASSESSMENT OF THE INDUSTRIAL ENERGY CONSERVATION PROGRAM. VOLUME 1: SUMMARY Final Report, Nov. 1980 - Jul. 1981
Sep. 1981 50 p refs
(Contract DE-AC01-80CS-40298)
(PB82-122755; NMAB-395-1) Avail: NTIS HC A03/MF A01 CSCL 10A

Findings and recommendations of the industrial energy conservation program are summarized. Industrial operations in the U.S. consume some 37% of the country's total energy. This percentage will increase to 50% by 1980 unless appropriate conservation measures are applied. Conservation measures are difficult to implement. It is concluded that improvements for conservation are needed in the areas of: project selection, project management, and transfer of results to industry. GRA

N82-22803# Department of Energy, Mines and Resources, Ottawa (Ontario). Center for Mineral and Energy Technology.
EFFECT OF HEATED DIESEL FUEL ON PARTICULATE GENERATION AND FUEL CONSUMPTION FOR A DEUTZ F6L 912 ENGINE
E. D. DAINTY and J. P. MOGAN Jun. 1980 10 p
(DE82-900385; ERP/ERL-80-65(TR)) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries

The effects of fuel temperature on fuel consumption and on the concentrations of CO and carbon particulate matter in the exhaust gases generated at near maximum load/speed operating conditions was determined. It is found that for a given engine torque and speed, and fuel temperature increases from 750 F/240 C to 180DF/830 C: there is no significant variation in fuel flow rate; there is no significant overall variation in the generation of particulate matter; and a minor 12% reduction in the generation of CO takes place. It dos not appear that this emissions reduction strategy is useful in underground applications where IDI engines are widely used. DOE

N82-22810# STEAG A.G., Essen (West Germany). Hauptbereich Kraftwirtschaft.
MELTING CHAMBER COMBUSTION WITH REDUCED EMISSION OF NITROGEN OXIDES Final Report
H. STEBEL and U. STRAUSS Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 32 p refs In GERMAN; ENGLISH summary Sponsored bu Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-228; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 7,55

A pilot plant intended to test a stoking concept, incorporating melting chambers with reduced emission of NOx, is described. Comparable liquefied coal combustion schemes show values of NOx emission of 950 to 1150 vpm. Values for the pilot plant of 650 vpm are realized, combining stable stoking of the melting chamber and flame optimization. It is found that it is possible to recirculate up to 14% of total flue gas through the combustion chamber. Under these conditions NOx emissions are reduced to 540 vpm, however, variable accommodation of the recirculated flue gas volume to the boiler load regime is necessary.
Author (ESA)

N82-22811# Southwest Research Inst., San Antonio, Tex. Dept. of Emissions Research.
CHARACTERIZATION OF EXHAUST EMISSIONS FROM HIGH MILEAGE CATALYST-EQUIPPED AUTOMOBILES
L. R. SMITH Sep. 1981 191 p refs
(Contract EPA-68-03-2884)
(PB82-131566; EPA-460/3-81-024) Avail: NTIS HC A09/MF A01 CSCL 13B

Ten automobiles were evaluated (as-received and after a tune-up to manufacturer's specifications) over the Light-Duty Federal Test Procedure (FTP) and the Highway Fuel Economy Driving Schedule (HFET). Exhaust constituents measured, in addition to the regulated emissions, include: aldehydes, particulates, sulfides, amines, metals, and several additional elements and compounds. Additional evaluations involved the measurement of the regulated emissions over four short-test procedures. GRA

N82-23043# Comptroller General of the United States, Washington, D.C.
STREAMLINING AND ENSURING MINERAL DEVELOPMENT MUST BEGIN AT LOCAL LAND MANAGEMENT LEVELS Report to the Chairman, Committee on Energy and Commerce, House of Representatives
4 Dec. 1981 24 p refs
(EMD-82-10; B-205344) Avail: SOD

A study of the use of Federal lands, particularly military lands, concluded that success in streamling and accelerating mineral development on Federal lands depends on the Bureau of Land Management state offices ultimately responsible for the implementation of Department of Interior minerals policies. It was

found the eastern States Office of the Bureau of Land Management did not effectively deal with potential Federal mineral trespass in the East, and was unable to issue mineral leases and permits on a timely basis. Moreover, it was unable to effectively deal with new areas of mineral interest because of Department actions. Recommendations to improve the mineral trespass program help relieve lease and permit backlogs, maintain dedicated staff, and improve headquarters communications with State offices were made. R.J.F.

N82-23068# Committee on Science and Technology (U. S. House).
THE 1983 NASA AUTHORIZATION, VOLUME 1
Washington GPO 1982 114 p Hearing before the Subcomm. on Transportation, Aviation and Mater. of the Comm. on Sci. and Technol., 97th Congr., 2nd Sess., No. 71, 17 Feb. 1982
(GPO-91-488-VOL-1) Avail: Subcommittee on Transportation, Aviation and Materials

The status of NASA systems technology programs which provide focused technology applications principally to civil aviation is addressed in light of the cost effectiveness of NASA's partnership with the aircraft industry and the economic impact of the reduction of NASA's roll in promoting advanced aeronautical technology. Progress made in research and technology programs encompassing aerodynamics, propulsion, materials and structures as well as controls and guidance, human factors, and low speed and high speed aircraft technology is reported. The six elements of the Aircraft Energy Efficiency program are highlighted. These are: engine component improvement, energy efficient engine, advanced turboprop, energy efficient transport, composite primary aircraft structures, and laminar flow control. The budget request for these programs is presented. N.W.

N82-23072# Arbeitsgemeinschaft Deutscher Verkehrsflughaefen, Stuttgart (West Germany).
PRESENT AND FUTURE ENERGY CONSUMPTION FOR PASSENGER TRANSPORTATION IN GERMANY [ENERGIEVERBRAUCH IM PERSONENFERNVERKEHR DER BUNDESREPUBLIK DEUTSCHLAND IN GEGENWART UND ZUKUNFT]
M. KUHNE and U. WOLFFRAM 1981 142 p refs In GERMAN
(ISBN-3-87977-051-4) Avail: NTIS HC A07/MF A01

Passenger transportation in Germany was investigated in order to determine real energy consumption. For typical passengers, energy consumption for overland travel and charter flights was studied. The energy needed for air traffic was compared with that for transportation overland (railway, car, bus), taking into account transportation to the airport or railway station. Transportation makes up about 17% of German primary energy consumption, i.e., road traffic 14%, railway traffic 1.6%, and air traffic 1%. Specific energy consumption (overland travel) of intercity trains, airplanes and cars is in the proportion 1.0 to 3.7 to 4.0 (1980) and is expected to be 1 to 2.4 to 3.1 by the year 2000. For holiday trips, specific energy consumption for bus, train, car and airplane travel is in the proportion 1.0 to 1.4 to 3.6 to 3.4 (1980) and is expected to be 1 to 1.4 to 2.5 to 2.9 by 2000. Author (ESA)

N82-23373# Solar Turbines International, San Diego, Calif.
HIGH TEMPERATURE METALLIC RECUPERATOR Annual Report, May 1980 - Apr. 1981
M. E. WARD, N. G. SOLMON, and C. E. SMELTZER Jun. 1981 130 p refs Sponsored by Gas Research Inst.
(PB82-141102; SR81-R-4861-15; GRI-80/0074) Avail: NTIS HC A07/MF A01 CSCL 13A

An industrial 4.5 MM Btu/hr axial counterflow recuperator, fabricated to deliver 1600 F combustion air, was designed to handle rapid cyclic loading, a long life, acceptable costs, and a low maintenance requirement. A cost benefit anlysis of a high temperature waste heat recovery system utilizing the recurperator and components capable of 1600 F combustion air preheat shows that this system would have a payback period of less than two years. Fifteen companies and industrial associations were interviewed and expressed great interest in recuperation in large energy consuming industries. Determination of long term environmental effects on candidate recuperator tubing alloys was completed. Alloys found to be acceptable in the 2200 F flue gas environment of a steel billet reheat furnace, were identified. GRA

N82-23533# Mueller Associates, Inc., Baltimore, Md.
A FLEET MANAGER'S GUIDE TO VEHICLES FOR VALID RESULTS
Feb. 1981 39 p refs Presented at DOE Conf. on Fleet Use of Unique Automotive Fuels, San Antonio, Tex., 13-14 Aug. 1980 Sponsored by DOE
(DOE/CS-56051/04) Avail: NTIS HC A03/MF A01

While the measurement of acquisition, maintenance, and insurance costs is relatively straightforward and amenable to standard cost accounting procedures, the measurement and extrapolation of fuel use (and costs) from limited test programs involves many subtleties which, if ignored, can lead to erroneous conclusions. Information is presented to aid the automotive fleet manager in setting up a test program to measure and estimate fleet fuel economy and fuel use. Other areas of economic interest may also be added. The collection and analysis of data from various tests, and methos for reporting results and performing life cycle cost analyses are included. A.R.H.

N82-23682# Pacific Northwest Lab., Richland, Wash.
FUEL CONSERVATION BY THE APPLICATION OF SPILL PREVENTION AND FAIL-SAFE ENGINEERING (A GUIDELINE MANUAL) Final Report
J. L. GOODIER, R. J. SICLARI, and P. A. GARRITY Jun. 1981 345 p refs
(Contract AC06-76-RL0-1830; EY-76-C-06-1830)
Avail: NTIS HC A15/MF A01

Spill prevention procedures are provided for maintaining a spill free plant during the transportation, transfer, storage and processing of petroleum products. The manual can be used to prevent spills of materials other than fuel oil. Special emphasis is given to failsafe engineering as an approach to preventing spills from the predominant cause-human failure. S.L.

N82-23734# Department of Energy, Washington, D. C. Office of Facility Planning and Support.
ENERGY CONSERVATION IN BUILDINGS AND GENERAL OPERATIONS Annual Report
Jan. 1981 26 p
(DE82-002723; DOE/MA-0004) Avail: NTIS HC A03/MF A01

An In-house Energy Management program designed to reduce energy consumption and increase energy efficiency in buildings and general operations facilities, is described. The major goals of the program are: retrofit of all buildings to improve energy efficiency and assure minimum life cycle costs by 1990; reduction, in existing DOE buildings by 20% and in new DOE buildings by 45%, of average energy use per gross square foot by FY 1985, as compared to FY 1975 usage; reduction of petroleum-based fuels use by 30% by FY 1985, as compared to FY 1975 usage; and discontinuation of petroleum in major fuel burning installations by FY 2000; discontinuation of the use of natural gas in MFBI by FY 2000; and implementation of cost effective solar and other renewable energy systems. DOE's active program in energy conservation surveys and studies, retrofit and maintenance improvements, procurement of fuel efficient vehicles, driver training, and employee awareness enabled the Department to reduce its energy consumption in FY 1980 by approximately 14%, as compared to the embargo year of 1973. DOE

N82-23754# Department of Energy, Washington, D. C. Energy Information Administration.
SHORT-TERM ENERGY OUTLOOK: METHODOLOGY
C. CORNETT, D. PAXSON, A. P. REZNEK, C. CHU, S. SITZER, N. GAMSON, J. P. CHILDRESS, S. PAUL, H. WEIGEL, S. SUTTON et al. May 1981 128 p 2 Vol.
(DE82-002940; DOE/EIA-0202/7-2) Avail: NTIS HC A07/MF A01

Detailed discussions of forecasting methodology and analytical topics concerning short-term energy markets are presented. Major assumptions necessary to make the energy forecasts are also discussed. Supplementary analyses of topics related to short-term energy forecasting are also given. The discussions relate to the forecasts prepared using the short term integrated forecasting system. This set of computer models uses data from various sources to develop energy supply and demand balances. Econmetric models used to predict the demand for petroleum products, natural gas, coal, and electricity are discussed. Price prediction models are also discussed. The role of oil inventories in world oil markets is reviewed. Various relationship between weather patterns and energy consumption are discussed. DOE

N82-23759# Board of Chosen Freeholders, Woodbury, N.J.
FEASIBILITY STUDY: CODISPOSAL WITH ENERGY RECOVERY FROM WASTEWATER SLUDGE AND MUNICIPAL REFUSE. PHASE 2, GLOUCESTER COUNTY, NEW JERSEY
Jul. 1981 157 p refs
(Contract DE-AC01-79CS-20212)
(DE82-000882; DOE/CS-20212/1) Avail: NTIS HC A08/MF A01

The feasibility of thermal reduction of dewatered sludge and mixed municipal refuse with steam recovery for generation of electricity is investigated. The Gloucester County Utilities Authority wastewater treatment complex would produce the sludge and benefit from the generated electricity from a waste to energy system located on adjacent property. DOE

N82-23761# General Electric Co., Washington, D. C.
ENERGY USE IN OFFICE BUILDINGS: ANALYSIS OF USE IN A RANDOM SAMPLE OF 1100 BUILDINGS
Jun. 1981 106 p refs
(Contract DE-AC01-79CS-20189)
(DE82-000518; DOE/CS-20189/3) Avail: NTIS HC A06/MF A01

The collection and analysis of an energy use data base obtained from a sample of approximately 1100 randomly selected major office buildings located in 20 US cities are reported. Information on the collection of the data and on the characteristics of the buildings for which data were gathered is given. A tabular analysis of the energy consumption data is performed by census division, fuel type, building age, height, downtown/suburban location, and class of space. The data base (denoted as the 20-city data base) is compared to the data base obtained from the experience exchange report denoted as the EER office building sample. Both data bases were for the year 1977. Tables present the comparison of the two data bases. In general the EER office building sample buildings used more energy than did the buildings in the 20-city data base: i.e., the buildings in the experience exchange report are biased towards higher energy use buildings. Furthermore, the EER office building sample has proportionally more gas and steam buildings than does the random sample. On a national basis the EER office building sample buildings used approximately 10% more energy than did the buildings in the 20-city data base in 1977. DOE

N82-23763# New England Congressional Inc., Washington, D.C.
ENERGY IN NEW ENGLAND: TRANSITION TO THE 80'S
R. KATZ, L. PAWLICK, and B. SPENCER 22 Jun. 1981 74 p refs
(DE82-000234; DOE/TIC-20002?-) Avail: NTIS HC A04/MF A01

Activities in New England which result in more efficient consumption of energy are discussed. Changes in aggregate energy demand since the oil embargo, energy use and the regional economy, incentives for conservation, and decline in electricity growth are also discussed. The contributions made by wood products, hydroelectric power, solid waste, solar, wind, alcohol fuels, peat, and tidal power are disclosed. Changes in consumption of individual conventional energy products (petroleum, natural gas, nuclear power, coal, purchased electricity) and activity currently underway in the conventional fuel area are summarized. DOE

N82-23769# Applied Forecasting and Analysis, Inc., Los Angeles, Calif.
DEMAND 80/81: FORECASTS OF ENERGY CONSUMPTION TO THE YEAR 2000. VOLUME 1: FORECASTS AND DESCRIPTION OF THE FORECASTING MODEL Final Report
A. M. BORGES and R. T. CROW Oct. 1981 120 p refs 2 Vol.
(Contract EPRI PROJ. 1747-1)
(DE82-900871; EPRI-EA-2078-VOL-1) Avail: NTIS HC A06/MF A01

National forecasts of end use consumption of electricity, liquid hydrocarbons, gaseous hydrocarbons, and coal are presented. The forecasts are based on an econometric model whose equations represent energy consumption of each form of energy in each end use sector. Each forecast is conditional upon a common forecast of long run economic growth, coupled with a scenario concerning energy prices and conservation policy. The scenarios are composed of four alternative sets of assumptions about energy prices and three alternative sets of assumptions on conservation policy. DOE

N82-23770# Applied Forecasting and Analysis, Inc., Los Angeles, Calif.
DEMAND 80/81: FORCASTS OF ENERGY CONSUMPTION TO THE YEAR 2000. VOLUME 2: APPENDIXES Final Report
A. M. BORGES, C. M. BOYCE, and R. T. CROW Oct. 1981 203 p 2 Vol.
(Contract EPRI PROJ. 1747-1)
(DE82-900870; EPRI-EA-2078-VOL-2) Avail: NTIS HC A10/MF A01

The forecasts cover each sector of the economy and are conditional upon alternative assumptions concerning national economic growth, energy prices, other prices, and conservation policy. The forecasts also include forms of energy other than electricity to provide a comprehensive energy picture. Although the forecasts proceed through time in one-year increments, their primary focus is on the period from 1985 to 2000. DOE

N82-23778# Department of Energy, Washington, D. C. Office of Energy Markets and End Use.
RESIDENTIAL ENERGY CONSUMPTION SURVEY (RECS): NATIONAL INTERIM ENERGY CONSUMPTION SURVEY, 1978-1979. HOUSEHOLD MONTHLY ENERGY CONSUMPTION AND EXPENDITURES. USER'S GUIDE
P. WINDELL Aug. 1981 60 p
(PB82-114919; DOE/DF-81/027A) Avail: NTIS HC A04/MF A01 CSCL 10A

Technical specifications and basic information necessary for the appropriate use of the machine readable magnetic tapes containing data from the National Interim Energy Consumption Survey. Household monthly energy consumption and expenditures records of the residential energy consumption survey are provided. Included are an overview of the Residential Energy Consumption Survey (RECS) effort as a whole and a brief description of this administration of the RECS, the National Interim Energy

Consumption Survey. Technical specifications for reading the tapes and descriptions of the contents of each of the files contained on the tape are given. T.M.

N82-23779# Department of Energy, Washington, D. C. Office of Energy Markets and End Use.
RESIDENTIAL ENERGY CONSUMPTION SURVEY (RECS): NATIONAL INTERIM ENERGY CONSUMPTION SURVEY, 1978-1979, HOUSEHOLD MONTHLY ENERGY CONSUMPTION AND EXPENDITURES. SHOPPER'S GUIDE
P. WINDELL Aug. 1981 27 p
(PB82-114927; DOE/DF-81/027B) Avail: NTIS HC A03/MF A01 CSCL 10A CSCL 10A

The data from the National Interim Energy Consumption Survey (NIECS) is available to the public on machine readable magnetic tapes. Brief overviews of the Residential Energy Consumption Survey as a whole and of the NIECS in particular is a brief description of each of the files included in this tape, and a list of the variables in the data set are included. A copy of the fuel supplier record form used to collect consumption and expenditure data for each of the sample households is also included. T.M.

N82-23780# D'Appolonia (E.) Consulting Engineers, Inc., Pittsburgh, Pa.
GEOTHERMAL ENERGY MARKET STUDY ON THE ATLANTIC COASTAL PLAIN: OCEAN CITY, MARYLAND GEOTHERMAL ENERGY EVALUATION
C. E. SCHUBERT Aug. 1981 53 p refs Prepared for Applied Physics Lab, Laurel, Md.
(Contract DOE-EX-78-A-38-1008; DE-AI01-79ET-27025)
(PB82-123050; JHU/APL/QM-81-109) Avail: NTIS HC A04/MF A01 CSCL 13A

Thermal energy benefits for a proposed recreational complex are discussed. Resource potential, resource utilization, costs, economics, feasibility are considered. An operation scenario is included N.W.

N82-23782# National Bureau of Standards, Washington, D.C. National Engineering Lab.
VALIDATION AND ASSESSMENT OF ENERGY MODELS. PROCEEDINGS Final Report
S. I. GASS, ed. Oct. 1981 262 p refs Proceedings of symp. held at Gaithersburg, Md., 19-21 May 1980 Sponsored in part by DOE
(PB82-123951; NBS-SP-616; LC-81-6000087) Avail: NTIS HC A12/MF A01 CSCL 10A

The symposium was organized with a two fold agenda to summarize the recent ideas and advances of model validation and assessment that have been applied to DOE energy models, and to hold workshops on key open questions that are of concern to the validation and assessment research community. Speakers addressed current and future practices, the EIA model validation program, model structure and data, and model credibility. Full day workshop sessions were held on the following topics: validating composite models, the measurement of model confidence, model structure and assessment, sensitivity and statistical analysis of models, and model assessment methodologies. GRA

N82-23783# California Energy Commission, Sacramento.
ENERGY TOMMORROW: CHALLENGES AND OPPORTUNITIES FOR CALIFORNIA Biennial Report, 1981
Jul. 1981 216 p refs
(PB82-117821; CAEC-75) Avail: NTIS HC A10/MF A01 CSCL 10A

The California Energy Commission presents its views on the critical energy issues for California in the next twenty years along with its official electricity demand forecast and assessments of other energy demand growth. Demand is compared to estimates of the potential contributions of conservation and various conventional and alternative energy supply projects. California's overdependence on oil is discussed and options for reducing petroleum use, particularly in the transportation sector were examined. The result is a series of policy recommendations for directing public and private investments into a diversity of energy options and for spreading the benefits and costs of these options broadly and fairly among California's citizens. T.M.

N82-23784# Department of Energy, Washington, D. C. Energy Information Administration.
STATE ENERGY DATA REPORT: STATISTICAL TABLES AND TECHNICAL DOCUMENTATION 1960 THROUGH 1979
Sep. 1981 530 p
(PB82-119470; DOE/DF-81/037A) Avail: NTIS HC A23/MF A01 CSCL 10A

All the data of the State Energy Data System (SEDS) is given. The data is used to estimate annual energy consumption by principal energy sources (coal, natural gas, petroleum, electricity), by major end-use sectors (residential, commercial, industrial, transportation, and electric utilities), and by state (50 states, the District of Columbia, and the United States). Data is organized alphabetically by energy source (fuel), by end-use sector or energy activity, by type of data and by state. Twenty data values are associated with each fuel-sector-type state grouping representing positionally the years 1960 through 1979. Data values in the file are expressed either as physical units, British thermal units, physical to Btu conversion factors or share factors. GRA

N82-23785*# National Bureau of Standards, Washington, D.C. Center for Materials Science.
DETECTION, DIAGNOSIS AND PROGNOSIS: CONTRIBUTION TO THE ENERGY CHALLENGE: PROCEEDINGS OF THE MEETING OF THE MECHANICAL FAILURES PREVENTION GROUP Final Report
T. R. SHIVES, ed. and W. A. WILLARD, ed. Oct. 1981 341 p refs Conf. held in Santa Monica, Calif., 7-9 Oct. 1980 Sponsored in part by NASA, ONR, and Naval Air Systems Command
(NASA-CR-168713; NAS 1.26:168713; PB82-120304; NBS-SP-622; LC-81-600125) Avail: NTIS HC A15/MF A01 CSCL 10A

The contribution of failure detection, diagnosis and prognosis to the energy challenge is discussed. Areas of special emphasis included energy management, techniques for failure detection in energy related systems, improved prognostic techniques for energy related systems and opportunities for detection, diagnosis and prognosis in the energy field. GRA

N82-23791# Mound Lab., Miamisburg, Ohio.
POTABLE WATER STANDARDS PROJECT Final Report
C. E. STYRON and H. E. MEYER 7 Apr. 1981 212 p refs
(Contract DE-AC04-76DP-00053; EY-76-C-04-0053)
(MLM-2819) Avail: NTIS HC A10/MF A01

The pollution of drinking water with tritium discharges from a nuclear power plant is discussed. Waste disposal practices are described. Management of tritiated wastes is discussed. Approaches to resolving the tritium pollution problem are discussed in light of Federal pollution standards that are now being exceeded. The effects on the local aquifer and proposed efforts to clean it up are discussed. R.J.F.

N82-23794# Department of Energy, Washington, D. C.
ENVIRONMENTAL READINESS DOCUMENT. INDUSTRIAL PROGRAMS, FISCAL YEAR 1980
Feb. 1981 175 p refs
(DOE/ERD-0031) Avail: NTIS HC A08/MF A01

The environmental readiness of nine technologies under development are discussed. The technologies are: heat pump grain drying, blended cement, acetylene from coal, polypropylene waste to fuel oil, foam drying textiles, microwave and vacuum drying, fuel saving paint plant, new fertilizer process, and high performance forge furnace. Environmental considerations relevant to each technology are discussed. Pollution control, occupational health and safety, and conformity to environmental regulations are discussed. R.J.F.

N82-23798# Bioassay Systems Corp., Woburn, Mass.
DEVELOPMENT OF ENVIRONMENTAL ASSESSMENT SCREENING CRITERIA FOR COAL-CONVERSION SOLID WASTES Technical Progress Report, 1 Jul. - 30 Sep. 1981
Z. REUVENY and D. M. HANSON Sep. 1981 11 p refs
(Contract DE-AC22-80PC-30098)
(DE82-000751; DOE/PC-30098/T3) Avail: NTIS HC A02/MF A01

The preparation of extracts from each of the three waste test samples from the Ft. Lewis solvent refined coal 2 pilot plant was completed as well as most of the health and ecological tests which comprise the test battery. The extraction procedures and the tests performed on the extracts are being evaluated and reassessed. DOE

N82-23806# Combustion Engineering, Inc., Windsor, Conn.
ENVIRONMENTAL REPORT: COMBUSTION ENGINEERING/GULF STATES UTILITIES COMPANY FUEL GAS DEMONSTRATION PLANT, WESTLAKE, LOUISIANA Final Report
Sep. 1981 237 p refs Prepared in cooperation with Radian Corp., Austin, Tex.
(Contract DE-AC02-80CH-10047)
(DE82-004141; DOE/CH-10047/1) Avail: NTIS HC A11/MF A01

The environmental impact of the construction and operation of a coal gasification demonstration plant within the confines of an existing power plant site is predicted. Solid waste disposal is predicted to require less than 60 acres of land within the plant boundary over a 20 year period. Compared to the ongoing activities at the power plant site, the demonstration plant will have a very small impact. Impacts beyond plant boundaries will be very slight. No significant environmental impacts are anticipated to result from the construction, operation, or final disposition of the demonstration plant. DOE

N82-23811# Oak Ridge National Lab., Tenn.
ANALYSIS OF ENVIRONMENTAL ISSUES RELATED TO SMALL-SCALE HYDROELECTRIC DEVELOPMENT. 5: INSTREAM FLOW NEEDS FOR FISHERY RESOURCES
J. M. LOAR and M. J. SALES Oct. 1981 135 p refs
(Contract W-7405-ENG-26)
(DE82-000901; ORNL/TM-7861) Avail: NTIS HC A07/MF A01

The growing recognition nationwide of the importance of protecting instream uses of water has coincided with the recent emphasis on the development of small-scale hydropower resources. The issue of instream flow maintenance in hydropower development is essentially a problem of evaluating the effects of planned modifications in hydrologic patterns. Because hydroelectric projects can alter natural flow regimes on both spatial and temporal scales, downstream water users, the aquatic ecosystem, and primarily fish, can be adversely affected. Numerous methods which differ in their use of hydrologic records, hydraulic simulation techniques, and habitat rating criteria were developed to assess the effects of stream flow regulation on aquatic biota and to provide instream flow recommendations. Consequently, guidance is needed to ensure that the most appropriate methods are selected for instream flow assessments at small-scale hydroelectric sites. DOE

N82-23813# Environmental Protection Agency, Ann Arbor, Mich. Control Technology Assessment and Characterization Branch.
MOBILE SOURCE EMISSIONS OF FORMALDEHYDE AND OTHER ALDEHYDES
P. M. CAREY May 1981 37 p refs
(PB82-118159; EPA/AA/CTAB/PA/81-11) Avail: NTIS HC A03/MF A01 CSCL 07D

The available vehicular aldehyde studies were summarized in an attempt to characterize aldehyde emissions from motor vehicles. Topics covered in these studies include aldehyde emission factors for unmodified and malfunction vehicle engine configurations, effects of fuel, mileage accumulation and temperature variations and aldehyde emissions from Diesel-equipped vehicles equipped with prototype light-duty Diesel oxidation catalysts. Thus, it was possible to obtain aldehyde data for standard conditions and for a variety of operating conditions. The Federal test procedure (FTP) was used for the light-duty vehicles and the 13-mode test procedure for the heavy-duty engines. The 2, 4 dinitrophenylhydrazine (DNPH) procedure was used for the sampling and analysis of the aldehydes. GRA

N82-23821# Environmental Protection Agency, Ann Arbor, Mich. Control Technology Assessment and Characterization Branch.
BRIEF SYNOPSIS OF EPA OFFICE OF RESEARCH AND DEVELOPMENT AND THE HEALTH EFFECTS INSTITUTE MOBILE SOURCE WORK
May 1981 27 p refs
(PB82-124421; EPA/AA/CTAB/PA/81-10) Avail: NTIS HC A03/MF A01 CSCL 13B

The work in progress by ORD, the pertinent results, and future work planned by ORD are discussed. Some of the important areas mentioned are; chemical characterization work, development of method to collect gas-phase hydrocarbons in diesel exhaust, effect of NO_2 in mutagen artifact generation, study of filter efficiency, and identification of types of compounds responsible for Ames test activity in diesel particles. T.M.

N82-23826# Environmental Protection Agency, Ann Arbor, Mich. Control Technology Assessment and Characterization Branch.
THE DETERMINATION OF A RANGE OF CONCERN FOR MOBILE SOURCE EMISSIONS OF SULFURIC ACID
C. A. HARVEY and R. J. GARBE Aug. 1981 29 p refs
(PB82-117870; EPA/AA/CTAB/PA/81-21) Avail: NTIS HC A03/MF A01 CSCL 13B

In light of the action called for in section 202(a)(4) of the Clean Air Act (CAA) and due to a concern within industry as to what emission levels will be used as the basis for the evaluation of current and future technologies, a methodology was developed in order to bracket a range of concern for various unregulated pollutants. The efforts from two EPA contracts are coordinated in order to use this methodology specifically for an evaluation of sulfuric acid. GRA

N82-24051*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GUIDE TO THE EVALUATION OF HUMAN EXPOSURE TO NOISE FROM LARGE WIND TURBINES
D. G. STEPHENS, K. P. SHEPHERD (Bionetics Corp., Hampton, Va.), H. H. HUBBARD (College of William and Mary, Newport News, Va.), and F. W. GROSVELD (Bionetics Corp., Hampton, Va.) Mar. 1982 71 p refs
(Contract NAS1-14970; NAG1-166)
(NASA-TM-83288; NAS 1.15:83288) Avail: NTIS HC A04/MF A01 CSCL 20A

Guidance for evaluating human exposure to wind turbine noise is provided and includes consideration of the source characteristics, the propagation to the receiver location, and the exposure of the receiver to the noise. The criteria for evaluation of human exposure are based on comparisons of the noise at the receiver location with the human perception thresholds for wind turbine noise and noise-induced building vibrations in the presence of background noise. B.W.

N82-24391# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
CALIFORNIA EXPERIENCE WITH ENERGY CONSERVATION STANDARDS FOR BUILDINGS
R. FEINBAUM May 1981 142 p refs
(Contract W-7405-ENG-48)
(DE81-000972; LBL-12731) Avail: NTIS HC A07/MF A01

Results of California's development and implementation study of its Title 24 Energy Conservation standards are presented. The Title 24 standards are compared with the National Building Energy Performance Standards. Results show implementation difficulties occurred in starting up the program and information dissemination. Local enforcement practices proved variable and ambiguities in

the standards created special problems for building officials. These problems are discussed in detail. Innovative approaches such as use of computer calculations proved difficult for approval and this problem is discussed. Attitudes toward standards are described. Details on the structure of the home building industry in California are given. Measures taken by the California Energy Commission to review and update the standards are described. DOE

N82-24648*# Engelhard Industries, Inc., Edison, N.J.
DEVELOP AND TEST FUEL CELL POWERED ON-SITE INTEGRATED TOTAL ENERGY SYSTEMS: PHASE 3: FULL-SCALE POWER PLANT DEVELOPMENT Quarterly Report, Aug. - Oct. 1981
28 Apr. 1982 59 p refs
(Contract DEN3-241; DE-AI-01-80ET-17088)
(NASA-CR-165568; DOE/NASA/0241-3; NAS 1.26:165568; QR-3)
Avail: NTIS HC A04/MF A01 CSCL 10B

The development of a commercially viable and cost-effective phospheric acid fuel cell powered on-site integrated energy system (OS/IES) is described. The fuel cell offers energy efficients in the range of 35-40% of the higher heating value of available fuels in the form of electrical energy. In addition, by utilizing the thermal energy generated for heating, ventilating and air-conditioning (HVAC), a fuel cell OS/IES could provide total energy efficiencies in the neighborhood of 80%. Also, the Engelhard fuel cell OS/IES offers the important incentive of replacing imported oil with domestically produced methanol, including coal-derived methanol. T.M.

N82-24661# Argonne National Lab., Ill.
DISTRIBUTED THERMAL ENERGY STORAGE IN THE RESIDENTIAL SECTOR: COMMERCIALIZATION READINESS ASSESSMENT AND IMPLEMENTATION STRATEGY
R. F. GIESE *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 31-32 Mar. 1981
Avail: NTIS HC A16/MF A01

Significant national benefits can result from the use of customer-sides-of-the-meter thermal energy storage (TES). It appears that TES for residential space heating and hot water heating can capture a market large enough to yield annual oil savings of approximately 80 million barrels (0.3 quads) by the year 2000. The readiness of each of three candidate TES systems for near-term commercialization was examined. It was concluded that of these, TES for residential space and hot water heating are technically and economically ready for commercialization. T.M.

N82-24693# TRW, Inc., McLean, Va. Energy Systems Planning Div.
A COST-EFFECTIVENESS EVALUATION OF CHEMICAL HEAT PUMPS
W. R. STANDLEY, R. GORMAN, P. S. MORITZ, and T. J. OGORMAN *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 159-162 Mar. 1981
Avail: NTIS HC A16/MF A01

Chemical heat pump technologies are compared with a baseline of existing HVAC technologies and a set of emerging competitive technologies. The basis for comparison is system cost effectiveness in one or more specific applications, with levelized annual cost taken as the measure of cost effectiveness. The specific applications are a residential building and a commercial building, each requiring HVAC services. An industrial process-heat upgrading application is also included. For each system, the net consumption of fossil fuel resources is evaluated, and environmental/safety aspects identified. Author

N82-24727# Pacific Northwest Lab., Richland, Wash.
OVERVIEW OF ENERGY-CONSERVATION RESEARCH OPPORTUNITIES. EXECUTIVE SUMMARY
W. J. HOPP, S. G. HAUSER, G. J. HANE, W. E. GURWELL, S. P. BIRD, W. C. CLIFF, R. E. WILLIFORD, T. A. WILLIAMS, and W. B. ASHTON Nov. 1981 21 p refs
(Contract DE-AC06-76RL-01830)
(DE82-004031; PNL-3944-EX-SUMM) Avail: NTIS HC A02/MF A01

Research opportunities that are important to developing advanced technologies for efficient energy use are presented. A wide array of attractive technical areas from which specific research and development programs could be implemented are described. Research areas are presented for potential application in each of the major energy end-use sectors. The analysis employs a systematic process for both identifying and screening candidate energy conservation research areas. Aggregate energy consumption was reviewed and explicity criteria were employed to evaluate the technology research areas. DOE

N82-24728# Pacific Northwest Lab., Richland, Wash.
BUILDING AND OCCUPANT CHARACTERISTICS AS DETERMINANTS OF RESIDENTIAL ENERGY CONSUMPTION
L. A. NIEVES and A. I. NIEVES Oct. 1981 82 p
(Contract DE-AC06-76RL-01830)
(DE82-002417; PNL-4012) Avail: NTIS HC A05/MF A01

The probable effects of building energy performance standards on energy consumption were studied. Observations of actual residential energy consumption that could affirm or disaffirm consumption estimates of the Department of Energy's 2.0A simulation model were obtained. Home owner's conservation investments and home purchase decisions were investigated. The investigation of determinants of household energy consumption is described. The underlying economic theory and its implications are given as well as a description of the data collection procedures, of the formulation of variables, and then of data analysis and findings. The assumptions and limitations of the energy use projections generated by the DOE 2.0A model are discussed. Actual electricity data for the houses are then compared with results of the simulation. DOE

N82-24731# Oak Ridge National Lab., Tenn.
ENERGY CONSUMED IN 2010 BY AN ENERGY-EFFICIENT BUILDING SECTOR
G. D. PINE Nov. 1981 71 p refs
(Contract W-7405-ENG-26)
(DE82-003520; ORNL-5772) Avail: NTIS HC A04/MF A01

The minimum practical energy consumption in the building sector in the year 2010 if an aggressive program of efficiency improvement were implemented was estimated. For the case of a 2% annual growth rate in real gross national product, an 0.8% annual growth in population, and a quadrupling of real fuel prices relative to the 1975 prices, we concluded that end-use fuel consumption by the building sector could be reduced to 7.7 exajoule (EJ) in 2010 compared to 18.0 EJ in 1977. This could be accomplished by using technologies that are available today or can be predicted with a high level of confidence to be available in 2010. No technological breakthroughs would be required, and no sacrifice in amenities would be necessary. Indeed, the real standard of living would improve. Futhermore, the results were only slightly sensitive to fuel prices; most efficiency improvements were attractive economically at today's fuel prices or at prices only slightly higher. DOE

N82-24842# Societe Nationale Industrielle Aerospatiale, Toulouse (France). Service Controle Automatique du Vol.
FLIGHT MANAGEMENT COMPUTER
J. GROSSIN 7 Jan. 1982 26 p In FRENCH Presented at Soc. des Electriciens et des Radioelectriciens (SEE), Nice, 26 Nov. 1981 Submitted for Publication
(SNIAS-821-111-110) Avail: NTIS HC A03/MF A01

Ways in which automatic flight control can reduce fuel consumption were investigated. Three domains were identified:

(1) thrust optimization, (2) optimization of in-flight aerodynamic configuration, and (3) flight plan optimization. The use of flight management computers to achieve these goals is discussed and recently developed equipment is depicted. System design and functions are explained. The choice of performance optimization criteria (cost index) is considered. How a flight management computer deals with horizontal navigation is treated as an example. Author (ESA)

N82-25110*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
POTENTIAL REDUCTION OF DSN UPLINK ENERGY COST
S. DOLINSKY and N. F. DEGROOT *In its* The Telecommun. and Data Acquisition Rept. p 151-166 15 Apr. 1982 refs
Avail: NTIS HC A09/MF A01 CSCL 09C

DSN Earth stations typically transmit more power than that required to meet minimum specifications for uplink performance. Energy and cost savings that could result from matching the uplink power to the amount required for specified performance are studied. The Galileo mission was selected as a case study. Although substantial reduction in transmitted energy is possible, potential savings in source energy (oil or electricity) savings are much less. This is because of the rising inefficiency in power conversion and radio frequency power generation that accompanies reduced power output. S.L.

N82-25239*# Hampton Inst., Va.
COST AND FUEL CONSUMPTION PER NAUTICAL MILE FOR TWO ENGINE JET TRANSPORTS USING OPTIM AND TRAGEN Final Report
J. F. WIGGS 30 Apr. 1982 280 p
(Contract NAG1-69)
(NASA-CR-168973; NAS 1.26:168973) Avail: NTIS HC A13/MF A01 CSCL 01C

The cost and fuel consumption per nautical mile for two engine jet transports are computed using OPTIM and TRAGEN. The savings in fuel and direct operating costs per nautical mile for each of the different types of optimal trajectories over a standard profile are shown. S.L.

N82-25336# Council for Scientific and Industrial Research, Pretoria (South Africa).
ON THE PROCESSING OF MANGANESE NODULES WITH SULPHUR CONTAINING REAGENTS
K. H. SCHWARZ and U. BOIN 1981 15 p refs Transl. into ENGLISH from Erzmetall (West Germany), v. 27, no. 7-8, 1974 p 341-345
(CSIR-TRANS-1603) Avail: NTIS HC A02/MF A01

Sulphating/roasting of manganese nodules and leaching with SO2 in a slurry are discussed as methods of breaking down manganese nodules. Roasting conditions, leaching parameters, and specific energy costs are addressed. Author

N82-25400# Environmental Protection Agency, Ann Arbor, Mich. Control Technology Assessment and Characterization Branch.
CURRENT STATUS OF EPA OFFICE OF MOBILE SOURCE AIR POLLUTION CONTROL CHARACTERIZATION PROJECTS: SUMMARY
T. M. BAINES Aug. 1981 68 p refs
(PB82-105909; EPA/AA/CTAB/PA/81-18) Avail: NTIS HC A04/MF A01 CSCL 21D

EPA-OMSAPC is conducting a thorough characterization of unregulated emissions on a variety of current and prototype engines. Extensive work is also underway to see how various fuel parameters affect regulated and unregulated emissions. This latter work includes projects on alternate fuels such as methanol as well as fuels derived from coal or oil shale. GRA

N82-25632 International Institute for Applied Systems Analysis, Laxenburg (Austria).
THE ENERGY SUPPLY MODEL MESSAGE
L. SCHRATTENHOLZER Dec. 1981 41 p refs
(RR-81-31; ISBN-3-7045-0024-0) Avail: Issuing Activity

A dynamic linear programming model that minimizes the total discounted costs of supplying a given set of energy demands over a given time is introduced. It balances secondary energy demand, disaggregated into sectors and exogenous to the model, with primary energy supply, a set of resource availabilities disaggregated into an optional number of cost categories by choosing from a set of energy conversion technologies. Model constraints reflect the limited speed of build up of technologies, the limited annual availability of resources, and technological relationships. The model defines load regions (e.g., for electricity demand), distinguishes between indigenous and imported resources, and optionally includes environmental impacts in the objective function. It can be applied to global or smaller scale scenarios. Author (ESA)

N82-25633# Committee on Science and Technology (U. S. House).
SUMMARY OF HEARINGS ON THE FUTURE OF THE NATION'S ENERGY UTILITIES: IMPLICATIONS FOR FEDERAL RD&D
K. NELSON and F. J. SISSINE Washington GOP 1982 45 p Presented to The Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 97th Congr., 2nd Sess., Mar. 1982 Prepared by the Library of Congr., Congr. Res. Serv.
(GPO-91-815) Avail: Subcommittee on Energy Development and Applications

Hearings on the future of the nation's energy utilities are summarized. The future strategies of energy utilities in regard to new technologies are considered. Alternate energy technologies, conservation, diversification, deregulation, and various regulatory reforms are explored. N.W.

N82-25634# Committee on Science and Technology (U. S. House).
NATIONAL ENERGY CONSERVATION POLICY UNDER THE REAGAN ADMINISTRATION: ANALYSIS OF HEARINGS ON THE DEPARTMENT OF ENERGY AUTHORIZATION FOR FISCAL YEAR 1982
F. J. SISSINE Washington GPO 1982 58 p Presented to the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 97th Congr., 2nd Sess., Mar. 1982 Prepared by the Library of Congr., Congr. Res. Serv.
(GPO-92-174) Avail: Subcommittee on Energy Development and Applications

Some of the major issues in energy conservation policy are summarized, including the significance of energy conservation to the national economy, foreign competition, and the prospects for increased private and local government participation. The role of the Federal Government in energy conservation, outreach, and information dissemination is discussed. R.J.F.

N82-25650# Mid-American Solar Energy Complex, Minneapolis, Minn.
RESIDENTIAL CONSERVATION SERVICE PROGRAM SUPPORT Final Report
Sep. 1981 11 p
(Contract DE-AC02-79CS-30150)
(DE82-001235; MASEC-R-81-080; A-102-4) Avail: NTIS HC A02/MF A01

Five tasks to research and prepare information for the Residential Conservation Program are described. The tasks are: preparing cost data on renewable program (specifically solar) measure; designing and publishing a consumer agency guide to advise consumers of preventive and corrective actions to take when contracting for home improvements; providing a report on financing residential energy improvements; designing solar industry information releases, specifically on solar water heaters; and preparing a brochure. DOE

N82-25652# Mid-American Solar Energy Complex, Minneapolis, Minn.
NATIONAL SOLAR DATA NETWORK SUCCESS STORIES
Sep. 1981 22 p
(Contract DE-AC02-79CS-30150)
(DE82-002281; MASEC-R-81-058) Avail: NTIS HC A02/MF A01

Three of the most successful applications in the MASEC reporting region are described. The three sites are the Scattergood School site in West Branch, Iowa; the South Dakota School of Mines site located at the Mount Rushmore Memorial Visitor's Center in Keystone, South Dakota, and the Telex Communications site in Blue Earth, Minnesota. The first is a school recreation center, the second a park recreation center, and the third a business. All three are active systems and each exhibits a variety of approaches to providing space and domestic water heating. The major success of each is that a substantial portion of the heating load was provided by solar energy. The success of the NSDN program is that it indictes the approaches and parts of the systems that seem to work best, so that conclusions can be made about which applications are appropriate in varying circumstances. A brief report is presented for each system explaining the system, the energy flow through the system, the total cost, and the energy saved per year. DOE

N82-25657# Science Research Council, Chilton (England).
HEAT ENERGY RECOVERY FROM DOMESTIC OUTPUT FLUIDS (HERDOF)
F. M. RUSSELL 1981 15 p refs
(PB82-134156; RL-81-074) Avail: NTIS HC A02/MF A01 CSCL 10/C

A device incorporating energy storage is described which permits recovery of part of the available heat energy in domestic output fluids. Preliminary estimates of the potential savings indicate the device should be examined in depth and practical tests conducted. The attitude of industry to the proposed device was considered and positive recommendations were made in that area. Author (GRA)

N82-25662# Corps of Engineers, Buffalo, N.Y.
US LAKE ERIE NATURAL GAS RESOURCE DEVELOPMENT. PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT Final Report
A. K. MARKS, P. J. HORVATIN, P. G. LEUCHNER, and V. SAULYS Mar. 1982 240 p refs Prepared in cooperation with EPA, Chicago
(AD-A112074) Avail: NTIS HC A11/MF A01 CSCL 13B

This report comprises an abbreviated statement which incorporates by reference the Draft Programmatic statement of the same title dated November 1980 for detailed information. The document summarizes the environmental impacts associated with development of natural gas beneath U.S. waters of Lake Erie's eastern and central basins bordering the States of New York, Pennsylvania, and Ohio; provides errata and addenda to the Draft statement; and responds to comments received on the Draft Statement. Major topics of discussion include: applicability of using the Canadian Lake Erie drilling experience; establishment of a Task Force and in each state an offshore office for program coordination; waste disposal methodology; need for natural gas; the role of the International Joint Commission, the 1909 U.S. - Canada Boundary Waters Treaty, and the 1978 Water Quality Agreement; the effects of resuspending sediment; validity of using worst-case accident analysis in lieu of Canadian accident data; contingency plans and spill cleanups; the effects of polyethylene glycol chlorination; impacts on water supplies and water treatment costs; an onland alternative program; and an explanation of the reference program concept. GRA

N82-25664# Los Alamos Scientific Lab., N. Mex.
SCREENING METHODOLOGY FOR CALCULATING WORST-CASE CONCENTRATIONS DOWNWIND FROM A LARGE, ISOLATED, AIR-POLLUTANT-EMISSION SOURCE
D. NOCHUMSON Sep. 1981 28 p refs
(Contract W-7405-ENG-36)
(DE82-002286; LA-8871-MS) Avail: NTIS HC A03/MF A01

A screening methodology to indicate whether a proposed source to be sited in a flat or high-terrain situation has the potential to violate ambient air quality standards was developed. The Gaussian plume formulation serves as a basic element of the methodology, which follows the guidelines recommended by the US Environmental Protection Agency for evaluating the air quality impacts of new stationary sources. A step-by-step procedure is given.to calculate maximum ground-level concentration of pollutants under a variety of worst-case conditions that depend upon terrain conditions and the controlling air quality standards. The methodology is applied to a case study that examines the siting of generic coal-fired power plants in the West and the constraints imposed by terrain and sulfur dioxide air quality standards. DOE

N82-25665# Los Alamos Scientific Lab., N. Mex.
ENVIRONMENTAL AND RADIOLOGICAL SAFETY STUDIES. INTERACTION OF (238)PUO2 HEAT SOURCES WITH TERRESTRIAL AND AQUATIC ENVIRONMENTS Progress Report, 1 Apr. - 30 Jun. 1981
G. M. MATLACK and J. H. PATTERSON Sep. 1981 6 p
(Contract W-7405-ENG-36)
(DE82-002439; LA-8996-PR) Avail: NTIS HC A02/MF A01

The containers for (238)PuO2 heat sources in radioisotope thermoelectric generators were tested. Studies of the effects on the heat source of terrestrial and aquatic environments to obtain data for design of even safer systems are described. Data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO2 dissolution rates, soil column experiments to measure sorption of plutonium by soils, and several aquatic experiments are described. DOE

N82-26050*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FUTURE FUELS AND ENGINES FOR RAILROAD LOCOMOTIVES. VOLUME 2: TECHNICAL DOCUMENT
S. G. LIDDLE 1 Nov. 1981 392 p refs
(Contract NAS7-100; DE-AI01-78CS-55151; EM-78-1-01-5151)
(NASA-CR-168983; JPL-PUB-81-101; NAS 1.26:168983) Avail: NTIS HC A17/MF A01 CSCL 13F

The potential for reducing the dependence of railroads on petroleum fuel, particularly Diesel No. 2 was studied. The study takes two approaches: to determine the use of Diesel No. 2 can be reduced through increased efficiency and conservation, and to use fuels other than Diesel No. 2 both in Diesel and other types of engines. Synthetic hydrocarbon fuels, probably derived from oil shale, will be needed if present diesel-electric locomotives continue to be used. S.L.

N82-26051*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY ANALYSIS OF A DOWNSIZED ADVANCED GAS-TURBINE ENGINE IN A SUBCOMPACT CAR
J. L. KLANN and R. L. JOHNSEN 1982 25 p refs Presented at the 18th Joint Propulsion Conf., Cleveland, 21-23 Jun. 1982
(Contract DE-AI01-77CS-51040)
(NASA-TM-82848; E-1218; NAS 1.15:82848; DOE/NASA/51040-40) Avail: NTIS HC A02/MF A01 CSCL 13F

Relative fuel economy advantages exist for a ceramic turbine engine when it is downsized for a small car were investigated. A 75 kW (100 hp) single shaft engine under development was analytically downsized to 37 kW (50 hp) and analyzed with a metal belt continuously variable transmission in a synthesized car. With gasoline, a 25% advantage was calculated over that of a current spark ignition engine, scaled to the same power, using the same transmission and car. With diesel fuel, a 21% advantage

was calculated over that of a similar diesel engine vehicle.
Author

N82-26054# Illinois Univ., Urbana-Champaign. Dept. of Civil Engineering.
URBAN TRANSPORTATION ENERGY ACCOUNTS. VOLUME 1: PROCEDURES. VOLUME 2: CASE STUDY OF THE CHICAGO REGION Final Report, Jun. 1978 - May 1981
D. E. BOYCE, M. C. ROMANOS, B. N. JANSON, P. PRASTACOS, M. FERRIS, and R. W. EASH (Chicago Area Transportation Study) Sep. 1981 255 p refs 2 Vol.
(Contract DOT-IL-11-0027)
(PB82-135542; UMTA-IL-11-0027-81-1) Avail: NTIS HC A12/MF A01 CSCL 10A

Procedures for compiling a set of urban transportation energy accounts are described. These procedures deal specifically with ground-mode person travel in an urbanized area but could be generalized to other modes, commodities and regions. There are several significant differences between these procedures and methods used by other studies to estimate the energy consumption of urban person trips. First, these procedures produce estimates of both direct and indirect energy consumption. Second, energy consumption is computed by mode for each origin-destination pair of zones. Third, automobile speeds and transit vehicle occupancies calculated for individual link flows are used to estimate energy consumption per person trip over each zone to zone trip path.
GRA

N82-26453# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ENERGY AND MATERIALS FLOWS IN THE PRODUCTION OF PRIMARY ALUMINUM
S. Y. SHEN Oct. 1981 52 p refs
(Contract W-31-109-ENG-38)
(DE82-005963; ANL/CNSV-21) Avail: NTIS HC A04/MF A01

The primary aluminum industry is one of the top five industrial energy users in the United States consuming about one quad annually. In 1980, for each ton of aluminum produced, an average smelting operation used about 157 million Btu of direct energy and another 70 million Btu were embodied in purchased materials. Producers employing the best practices used approximately 15% less energy per ton, or 132 million Btu of direct energy and 52 million Btu of embodied energy. These energy and materials flows are described in detail, using availability and input/output analyses and industry estimates. Energy consumption could be reduced further by developing (1) economical processes for using domestic nonbauxitic raw materials; (2) bulk alumina feeding equipment for handling more than one grade of alumina; (3) a reduction cell meter and temperature sensor for automatic control of alumina feeding and cell temperature; (4) a method for quickly and frequently measuring the NaF/AlF3 ratio in a reduction cell for tighter control of electrolyte composition; and (5) a method for recovering waste heat.
DOE

N82-26490# Department of Energy, Washington, D. C. Office of Transportation Programs.
SYMPOSIUM ON COMMERCIAL AVIATION ENERGY CONSERVATION STRATEGIES, PAPERS AND PRESENTATIONS
Apr. 1981 354 p refs Symp. held in Washington, D.C., 2-3 Apr. 1981 Sponsored in part by FAA
(AD-A107106) Avail: NTIS HC A16/MF A01 CSCL 21D

The Symposium provided a forum in which representatives from DOE, FAA, National Aeronautics and Space Administration (NASA) and the aviation industry exchanged information and ideas regarding current and future efforts to conserve fuel and to promote energy conservation within the commercial aviation sector. General topics discussed included Federal and industry energy conservation programs such as flight operations, air traffic control, engineering and maintenance, and corporate management strategies. The Symposium, was highlighted by a panel discussion entitled 'Energy Conservation: Where Do We Go From Here?' This report contains the papers and presentations from the Symposium.
GRA

N82-26512# Brookhaven National Lab., Upton, N. Y.
FUTURE RAW MATERIALS AND ENERGY USE IN INDUSTRY: A RESEARCH AGENDA
T. E. OHARE and F. J. SALZANO Jun. 1981 224 p Workshop Held at Reston, Va., 9-10 Nov. 1978
(Contract DE-AC02-76CH-00016)
(DE82-005975; BNL-51382) Avail: NTIS HC A10/MF A01

Research programs that might lead to a major reduction in the usage of energy and industrial raw materials in 21st century technology were discussed. The working panels considered agricultural technology; chemicals and polymers; construction; forest products, pulp and paper; glass, cement, and ceramics; information processing and machine intelligence; iron and steel processing; manufacturing; nonferrous metals processing; raw materials, exploration and extraction; technological education and engineering practices; and textiles. Research profiles and selected research projects and programs for the industries considered are included.
DOE

N82-26513# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
CASE STUDY OF THE MASTIN DOUBLE-ENVELOPE HOUSE
R. F. JONES, G. DENNEHY, H. T. GHAFFARI, and G. E. MUNSON May 1981 75 p refs
(Contract DE-AC02-76CH-00016)
(DE82-006833; BNL-51460) Avail: NTIS HC A04/MF A01

An evaluation is made of a double-envelope house of Ekose, a design built by Robert Mastin in Middletown, Rhode Island. The home has two shells with an airspace between through which air can circulate. Performance monitoring of the house in the heating season showed that the requirements for auxiliary heat are very low, about 2.1 Btu per square foot of floor space per degree-day. Design changes are identified which could reduce the heating requirement even further. This ranks the house among the most energy-efficient building designs available today. It is concluded that the low heating needs of the house are due primarily to the excellent insulative value of the double shell.
DOE

N82-26788# General Accounting Office, Washington, D. C. Procurement, Logistics, and Readiness Div.
BUILDING ENERGY ANALYSIS COMPUTER PROGRAMS DEVELOPED BY FEDERAL AGENCIES: COST, USE, AND NEED
22 Mar. 1982 13 p
(PLRD-82-47) Avail: NTIS HC A02/MF A01

The need for further government development of energy analysis computer programs is questioned, and termination of current development efforts is recommended.
Author

N82-26789# General Accounting Office, Washington, D. C.
MITIGATING SOCIOECONOMIC IMPACTS OF ENERGY DEVELOPMENT
2 Mar. 1982 81 p refs
(EMD-82-13) Avail: NTIS HC A05/MF A01

Information is provided on energy resource development and the efforts of states and local communities to deal with the related social and economic impacts. Information is also provided on the range of options and resources generally available to states and local communities from local, state, industry and Federal sources to plan for an mitigate the adverse effects of energy development. Faced with reductions in Federal assistance communities will have to depend more on alternate sources.
L.F.M.

N82-26808# General Accounting Office, Washington, D. C. Energy and Minerals Div.
GREATER ENERGY EFFICIENCY CAN BE ACHIEVED THROUGH LAND USE MANAGEMENT Report to the Congress
21 Dec. 1981 59 p
(AD-A111552; GAO/EMD-82-1) Avail: NTIS HC A04/MF A01 CSCL 13B

When planning new growth and redevelopment, communities can significantly reduce energy consumption by incorporating energy-efficient land use concepts such as site and building design,

locational planning, and higher density development. Decisionmakers, however, are reluctant to use these concepts because of major barriers such as the cost of implementing the concepts and resistance to higher density development. The Federal Government can play a role in promoting energy-efficient land use by providing guidance through its policies, supporting research and comprehensive planning, and providing needed financial incentives. Author (GRA)

N82-26845# Argonne National Lab., Ill.
ENERGY-PERFORMANCE TARGETS FOR FEDERAL BUILDINGS: RETROFIT ENERGY-TARGET BANDS FOR EXISTING POSTAL FACILITIES Final Report
Apr. 1981 142 p refs
(Contract W-31-109-ENG-38)
(DE82-000070; ANL/ENG-81-01) Avail: NTIS HC A07/MF A01

A cost-effective energy performance target band was developed for postal facilities. For the retrofit energy target bands for existing postal facilities, buildings were classified into four sizes and two special use categories: namely, less than 5001 ft; 5001 to 25,000 ft; 25,001 to 100,000 ft; larger than 100,000 ft; vehicle maintenance facility (VMF) and bulk mail centers. A random statistical sample of buildings representative of the population was selected from each size category and one each from the VMF and BMC categories. Each building of the sample was then modeled and analyzed for annual energy consumption, using the DOE 2.1A computer program. For energy conservation purposes, the design parameters of existing buildings were modified, and, for each change, a computer simulation analysis was made to determine what impact the change had on the annual energy use. DOE

N82-26848# Department of Energy, Washington, D. C. Office of Market Analysis.
INTERNATIONAL ENERGY INDICATORS, OCTOBER-NOVEMBER 1981
E. ROSSI, JR., ed. 1981 26 p refs
(DE82-004101; DOE/IA-0010/15) Avail: NTIS HC A03/MF A01

Detailed data are presented for energy indicators in tables and graphs. Specific international data are presented: world crude oil production, 1974 to July 1981; OPEC crude oil productive capacity; world crude oil and refined product inventory levels, 1975 through the first half of 1981; oil consumption in OFCD countries, 1975 through the first half of 1981; USSR crude oil production, 1975 through July 1981; and free world and US nuclear electricity generation, 1973 through September 1981 and current capacity. Data presented for energy indicators in the US are: US domestic oil supply and crude oil production, 1977 through March 1981; US gross imports of crude oil and products, 1973 through August 1981; landed cost of Saudi crude oil in current and 1974 dollars; US coal trade, 1975 through July 1981; US natural gas trade, 1975 through August 1981; summary of US merchandise trade, 1977 through the first half of 1981; and the energy/gross national product ratio from 1974 through the first half of 1981. DOE

N82-26849# TRW, Inc., McLean, Va. Energy Engineering Div.
INDUSTRIAL COGENERATION OPTIMIZATION PROGRAM: A SUMMARY OF TWO STUDIES
Aug. 1981 38 p
(Contract W-7405-ENG-26)
(DE82-005587; DOE/TIC-11604) Avail: NTIS HC A03/MF A01

Two industrial cogeneration optimization programs were performed to examine the economic and energy saving impacts of adding cogeneration to site specific plants in the chemical, food, pulp and paper, petroleum refining, and textile industries. Industrial cogeneration is reviewed. The two parallel ICOP studies are described. The five industrial sectors are also described, followed by highlights of each of the site specific case studies. Steam turbine cogeneration systems fired by coal or alternative fuels are generally the most attractive in terms of economic performance and oil/gas savings potential. Of the 15 cogeneration systems selected as optimum in the ICOP studies, 11 were coal or wood fired steam turbines. By contrast, gas turbines, combined cycles, and diesel engines, which are limited to oil or gas firing, are usually less economical. DOE

N82-26854# California Univ., Livermore. Lawrence Livermore Lab.
DIRECT USE OF HYDROTHERMAL ENERGY: A REVIEW OF ENVIRONMENTAL ASPECTS
K. OBANION and D. LAYTON 28 Aug. 1981 56 p refs
(Contract W-7405-ENG-48)
(DE82-000069; UCRL-53196) Avail: NTIS HC A04/MF A01

The potential environmental impacts of the exploration, development, and production of hydrothermal geothermal energy for direct use applications are reviewed and evaluated. Mitigation strategies and research and development needs are included. DOE

N82-26855# California Univ., Livermore. Lawrence Livermore Lab.
US ENERGY FLOW, 1980
C. K. BRIGGS and I. Y. BORG 21 Oct. 1981 15 p refs
(Contract W-7405-ENG-48)
(DE82-002647; UCID-19227-80) Avail: NTIS HC A02/MF A01

The energy flow diagram illustrates energy sources and end uses in a single figure. The total energy consumption in 1980 was 75 quads which is 3.6% below 1979. Oil continued to be the largest single source of energy to the US by comprising 34 quads or 45% of the total used. Natural gas and coal make up 28% and 22% of the remainder. Oil imports fall 19.2% below 1979 levels resulting in a 9.2% net decrease in total oil use from 1979. There was a consequent drop in total energy consumption which was not compensated by increased overall use of either natural gas, which actually fell, or coal, which increased slightly. Coal exports increased 41%. Conversion to fuels other than oil for electrical power generation continued; coal and natural gas use for this purpose increased 7.6 and 5.5% respectively over 1979. Nuclear energy produced about the same amount of power in 1980 as in 1979. DOE

N82-26862# Hittman Associates, Inc., Columbia, Md.
DATA ON ENERGY CONSERVATION ACTIVITY IN MULTIFAMILY HOUSING Final Report
Jul. 1981 156 p refs
(Contract DE-AC01-79PE-70044)
(DE82-000467; DOE/PE-70044/T4; H-C1011/007-81-1002F)
Avail: NTIS HC A08/MF A01

A policy review to determine how the multifamily building sector is responding to market signals and to evaluate what role the federal government should play in encouraging conservation in this subsector is presented. Available data is used to assess the current status of weatherization in multifamily housing and the current trends in adding weatherization measures on using them in new construction are identified and catalogued. Data on energy practices in multifamily housing and other energy related characteristics are also identified. The purpose, the sources covered, and the findings and recommendations are described. The data are summarized. DOE

N82-26864# Charles River Associates, Inc., Boston, Mass.
USES OF THE FRS DATA BASE FOR ENERGY POLICY ANALYSIS
15 Oct. 1981 27 p refs
(Contract DE-AC01-81I-10752)
(DE82-001662; DOE/EIA-10752/T4; CRA-591) Avail: NTIS HC A03/MF A01

The possible uses of the financial reporting service (FRS) data base for the purposes of formulating and implementing federal energy policy federal policy regarding competition are analyzed. The potential use of the FRS system to analyze issues of competition, both at the sectoral level and across sectors are outlined and the use of the FRS system in energy policy analysis is discussed. The usefulness of firm level FRS data in determining the outcome of public policy on broad aggregates such as total exploration activity, as well as the application of FRS data in the

analysis of differential impacts of policy among firms are also considered. DOE

N82-26873# Air Force Engineering and Services Center, Tyndall AFB, Fla. Engineering and Services Lab.
THE BIOLOGICAL DEGRADATION OF SPILLED JET FUELS: A LITERATURE REVIEW Final Report, Jun. - Aug. 1981
R. E. CARLSON Oct. 1981 41 p refs
(Contract AF PROJ. 1900)
(AD-A110758; AFESC/ESL-TR-81-50) Avail: NTIS HC A03/MF A01 CSCL 06F

Biodegradation of many of the components of Air Force fuels does occur, although most studies have been done under laboratory conditions, and the extrapolation of the findings to natural rates of biodegradation is premature. Many factors affect biodegradation rates, including the nature and concentration of the specific hydrocarbon compound, the species of bacteria present and their quantity, and environmental factors such as nutrient availability, temperature, and oxygen concentrations. Initial concerns should be first, the determination of the importance of biodegradation relative to other loss factors such as volatilization and sediment sorption, and second, the determination of the ultimate fate of recalcitrant compounds and their metabolites. Author (GRA)

N82-26879# Brigham Young Univ., Provo, Utah. Combustion Lab.
BASIC COMBUSTION AND POLLUTANT FORMATION PROCESSES FOR PULVERIZED FUELS Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981
G. J. GERMANE and L. D. SMOOT 15 Oct. 1981 44 p refs
(Contract DE-FG22-80PC-30306)
(DE82-002238; DOE/PC-30306/T4; QTPR-4) Avail: NTIS HC A03/MF A01

Basic combustion and pollutant formation processes for pulverized solid fossil fuels include coal-water mixtures and chars derived from coal pyrolysis, liquefaction or gasification processes. The factors that affect the physical properties of coal-water mixtures (CWM) were identified and characterization tests initiated to determine how these variables (e.g., solids loading, particle size, particle size distribution, additives) affect the coal slurries. A bench scale apparatus consisting of a pressure vessel and an atomizing nozzle was designed and is being fabricated. This apparatus assists in the development of handling and atomization techniques for the combustion tests. It also aids in comparing viscosities of slurries of different solids loadings and coal types. Chars were obtained for characterization tests. A series of potential tests to characterize the chars was identified. Grading and sizing of the chars was begun as well as elemental analysis. DOE

N82-26880# Texas Univ., Austin. Center for Energy Studies.
ACID RAIN IN TEXAS' ENERGY FUTURE
R. R. ARENA Aug. 1981 53 p refs
(DE82-900465; UT/CES-ES-7) Avail: NTIS HC A04/MF A01

Texas lignite as a substitute fuel for petroleum and natural gas, currently the mainstays of the Texas electric power-generating industry is considered. Acid rain may result from the use of Texas lignite for power generation under existing federal and state air pollution standards. DOE

N82-26881# California Univ., Los Angeles.
ENVIRONMENTAL EFFECTS OF SOLAR-THERMAL POWER SYSTEMS. ENVIRONMENTAL EFFECTS OF HEAT TRANSFER AND STORAGE FLUIDS: PLANT TOXICITY AND MOVEMENT IN SOILS
H. NISHITA and R. M. HAUG Jul. 1981 47 p refs
(Contract DE-AC03-76SF-00012)
(DE82-002603; UCLA-12-1301) Avail: NTIS HC A03/MF A01

Field experiments on the movement of several heat transfer and storage oils (Therminol 66, Caloria HT43, and Dow 200) in soil and on the plant toxicity of these materials were conducted. These studies were conducted in an area where the soil is nonsaline and calcareous, and the vegetation is mostly Larrea tridentata with Oryzopsis hymenoides, Ambrosia dumosa, and Lycium andersonii. The abiotic factors (air and soil temperatures, rainfall, and soil moisture tension) were monitored during the experimental period and are discussed. The movement of the oils in the soil was determined in two ways - soil columns in plastic boxes and bare-soil plots. In plastic boxes, Therminol 66 moved downward about 6.3 cm in 281 days. Dow 200 moved about 3.8 cm in 281 days and showed virtually no further downward movement to the end of experimental period (555 days). In the bare-soil plots, the limit of downward movement of the oils during the experimental period was 20.6 cm, 18.7, and 14.9 cm for Therminol 66, Caloria HT43, and Dow 200, respectively. DOE

N82-26882# California Univ., Los Angeles. Lab. of Biomedical and Environmental Sciences.
ENVIRONMENTAL EFFECTS OF SOLAR-THERMAL POWER SYSTEMS. THE POTENTIAL PRODUCTION OF AIR POLLUTANTS NEAR STPS RECEIVER STATIONS
R. L. PERRINE, L. M. LIBBY, and M. SIMPSON Sep. 1981 57 p refs
(Contract DE-AG03-76SF-00012)
(DE82-002413; UCLA-12-1313) Avail: NTIS HC A04/MF A01

Data and analysis addressing the potential production of air pollutants in the high temperature, high solar intensity beam environment adjacent to a solar-thermal power system (STPTS) receiver are presented. Results, (chemical equilibria, chemical kinetics, mass emission rates transport and dispersion), indicate that some air pollutants may be produced as a result of operation of large scale central receiver STPS in quantities sufficient to be of regulatory concern. These will require steps toward management. Primary concern focuses on nitric oxide, and its downstream potential pollutant products. In all likelihood the quantities produced will be small, and fully merit for solar its general recognition as an environmentally benign energy technology. Furthermore, for many solar configurations and modes of operation even this limited concern may not apply. Worst case conditions, however, are capable of leading to significant impacts from large scale high temperature STPS facilities. DOE

N82-26889# Exxon Research and Engineering Co., Linden, N.J. Products Research Div.
SULFATE CONTROL TECHNOLOGY VEHICLE TESTING Final Report
D. F. HESS, M. H. KEIRNS, and K. C. BACHMAN Dec. 1981 88 p refs
(Contract EPA-68-03-2342)
(PB82-154345; EPA-460/3-81-035) Avail: NTIS HC A05/MF A01 CSCL 13B

A total of four vehicles, two low excess air-oxidation catalyst systems and two three-way catalyst systems, were built to demonstrate the feasibility of low sulfate production automotive emission control technology. The general conclusions are summarized: (1) to successfully implement the low excess air concept the engine's fuel metering system must be capable of controlling the A/F ratio at the required 'slightly lean' value regardless of vehicle driving mode; (2) the oxidation catalyst bed must light-off quickly from cold start conditions; (3) the three-way catalyst must be maintained within its operating window by precise control of the engine at a stoichiometric A/F ratio. GRA

N82-26966# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
TOXICOLOGY OF HIGH ENERGY FUELS
M. G. MACNAUGHTON Dec. 1981 16 p refs
(Contract AF PROJ. 6302)
(AD-A111686; AFAMRL-TR-81-136) Avail: NTIS HC A02/MF A01 CSCL 06B

The development of new weapons systems, high energy fuels, and aerospace materials presents a challenge to the health professional. To avoid health hazards to Air Force personnel these hazards must be identified early in the research phase of development before acquisition decisions are made. This is only possible if the health professional works closely with the design engineers and scientists. The Air Force program to develop high

energy cruise missile fuels is a good example of close cooperation between scientists developing these fuels and toxicologists and environmental engineers responsible for research to assess the health and environmental consequences of their deployment throughout the Air Force. A status report is given on the extensive toxicology data base research effort on these fuels. Included are data on acute, chronic and oncogenic exposures; mutagenic screening tests and emergency exposure limits. Author (GRA)

N82-27194# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
UTILIZATION OF FLYWHEEL-HYBRID DRIVE TRAINS FOR COMMERCIAL TAXICAB VEHICLES
D. EISENHAURE, J. DOWNER, T. BLIAMPTIS, and B. JOHNSON Jul. 1981 79 p refs
(Contract W-7405-ENG-48)
(DE82-001670; UCRL-15395) Avail: NTIS HC A05/MF A01

The economic criteria, technical requirements, and conservation potential of flywheel hybrid drive train, utilized in taxicabs operated in commercial fleets are quantified. The development requirements for this application are identified in light of these factors. Use of hybrid drive trains in urban taxicabs was shown to make substantial fuel efficiency gains possible. For the vehicle used in this study, the projected gains are from an existing 10.5 mpg to a maximum of 32 mpg.
DOE

N82-27195# California Univ., Livermore. Lawrence Livermore Lab.
STUDY OF ACCUMULATOR PASSENGER CARS BASED ON THE IFIELD HYDROSTATIC PUMP/MOTOR UNIT
N. H. BEACHLEY and D. R. OTIS 24 Aug. 1981 140 p refs
(Contract W-7405-ENG-48)
(DE82-002522; UCRL-15390) Avail: NTIS HC A07/MF A01

A hydrostatic variable displacement pump/motor unit, called the Ifield accumulator, has significantly higher efficiencies than any other known units, and has the potential to make high mileage accumulator vehicles a practical reality. A preliminary study to determine the potential fuel economy improvement of an Ifield accumulator vehicle, and whether or not additional research and development work in this area is justified is presented. Efficiency data in equation form was provided by Ifield. The calculated results are quite promising, indicating mileage on the order of 60 mpg for a 3000 lb vehicle over the federal urban driving cycle (FUDC), and mileage on the order of 85 mpg for the New York City cycle. These figures appear to be feasible not only on a system with two pump/motor units, but on one with a single pump/motor unit. Fuel economy figures compare favorably with those of a comparable flywheel energy storage vehicle. The above figures are based on the use of accumulators with plastic foam as a heat sink to provide nearly isothermal operation with correspondingly low thermodynamic losses. With a conventional accumulator, the fuel mileage calculated for the FUDC drops approximately 9%. The required accumulator weight is calculated to be about 100 lb, using state of the art composite construction. Foam, if used, would add approximately 30% to the weight.
DOE

N82-27280*# Operations Research, Inc., Silver Spring, Md.
BENEFIT COST ANALYSIS OF THE AIRCRAFT ENERGY EFFICIENCY PROGRAM Final Report
J. BAUCHSPIES, F. HOPKINS, and L. KAPLAN Nov. 1980 242 p refs Revised
(Contract NASW-2961)
(NASA-CR-169116; NAS 1.26:169116) Avail: NTIS HC A11/MF A01 CSCL 01C

Analyses were reviewed in light of rapid and dramatic changes in fuel cost and availability, as well as significant changes in the economic and political climate relating to these factors. N.W.

N82-27452# Sassi Corp., Indianapolis, Ind.
PROCESS SELECTION AND INVESTMENT ANALYSIS, METHANATION FACILITY FOR PUROX PYROLYSIS SYSTEM OFF-GAS
Sep. 1981 173 p
(Contract DE-AC01-79CS-20449)
(DE82-004584; DOE/CS-20449/1) Avail: NTIS HC A08/MF A01

The Sassi Corporation of Indianapolis, Indiana, is investigating the commercial viability of converting refuse (trash and garbage) to synthetic natural gas. This conversion is accomplished by: (1) shredding and preparing the refuse for conversion; (2) producing a gas of low calorific value from the refuse using the Union Carbide Purox Process; and (3) methanating the Purox off-gas to a quality suitable for sale in the existing gas distribution system. Based on the scheme envisioned, a process design has been prepared for a facility which processes 46.87 MMSCFD of Purox off-gas, resulting in 26.4 MMSCFD of SNG. A detailed process description, process flow diagram, and a detailed description of the mechanical aspects of the plant are included in this report. Investment analysis reveals that capital requirements for the facility are approximately $47,320,000, resulting in a payout, not including taxes or interest, of 8.3 years.
DOE

N82-27743*# Curtiss-Wright Corp., Wood-Ridge, N.J. Rotary Engine Facility.
ADVANCED STRATIFIED CHARGE ROTARY AIRCRAFT ENGINE DESIGN STUDY
P. BADGLEY, M. BERKOWITZ, C. JONES, D. MYERS, E. NORWOOD, W. B. PRATT, D. R. ELLIS (Cessna Aircraft Corp.), G. HUGGINS (Cessna Aircraft Corp.), A. MUELLER (Cessna Aircraft Corp.), and J. H. HEMBREY (Cessna Aircraft Corp.) 29 Jan. 1982 149 p refs
(Contract NAS3-21285)
(NASA-CR-165398; NAS 1.26:165398; CW-WR-81.021) Avail: NTIS HC A07/MF A01 CSCL 21A

A technology base of new developments which offered potential benefits to a general aviation engine was compiled and ranked. Using design approaches selected from the ranked list, conceptual design studies were performed of an advanced and a highly advanced engine sized to provide 186/250 shaft Kw/HP under cruise conditions at 7620/25,000 m/ft altitude. These are turbocharged, direct-injected stratified charge engines intended for commercial introduction in the early 1990's. The engine descriptive data includes tables, curves, and drawings depicting configuration, performance, weights and sizes, heat rejection, ignition and fuel injection system descriptions, maintenance requirements, and scaling data for varying power. An engine-airframe integration study of the resulting engines in advanced airframes was performed on a comparative basis with current production type engines. The results show airplane performance, costs, noise & installation factors. The rotary-engined airplanes display substantial improvements over the baseline, including 30 to 35% lower fuel usage.
A.R.H.

N82-27802# Tennessee Valley Authority, Chattanooga. Office of Natural Resources.
REMOTE SENSING OF SULFUR DIOXIDE EFFECTS ON VEGETATION. VOLUME 1: SUMMARY Final Report
C. D. SAPP Jul. 1981 31 p 2 Vol.
(Contract EPA-IAG-D8-E721)
(DE82-900580; TVA/ONR/ARP-81/5-VOL-1; EPA-660/7-81-113) Avail: NTIS HC A03/MF A01

Three techniques for detecting and mapping sulfur dioxide (SO_2) effects on the foliage of sensitive crops and trees near large, coal-fired power plants were tested and evaluated: spectroradiometry, photometric analysis of aerial photographs, and computer analysis of airborne multispectral scanner data. DOE

N82-27803# Tennessee Valley Authority, Chattanooga. Office of Natural Resources.
REMOTE SENSING OF SULFUR DIOXIDE EFFECTS ON VEGETATION. VOLUME 2: DATA Final Report
C. D. SAPP Jul. 1981 280 p refs 2 Vol.
(Contract EPA-IAG-D8-E721)
(DE82-900581; TVA/ONR/ARP-81/6-VOL-2; EPA-600/7-81-114)
Avail: NTIS HC A13/MF A01

Airborne multispectral scanner data covering affected soybean fields were analyzed using three computer-assisted procedures: unsupervised, supervised, and pseudosupervised. The last method provided the best results. LANDSAT imagery was also investigated, but the foliar effects of SO2 were too subtle to detect from orbit. DOE

N82-27843# United Technologies Research Center, East Hartford, Conn.
TECHNICAL AND ECONOMIC ASSESSMENT OF FLUIDIZED-BED-AUGMENTED COMPRESSED-AIR ENERGY-STORAGE SYSTEM: SYSTEM LOAD FOLLOWING CAPABILITY
R. D. LESSARD, W. A. BLECHER, and D. MERRICK (Coal Processing Consultants Limited) Sep. 1981 225 p refs Prepared for Pacific Northwest Lab.
(Contract DE-AC06-76RL-01830)
(DE82-000958; PNL-3895) Avail: NTIS HC A10/MF A01

The load-following capability of fluidized bed combustion-augmented compressed air energy storage systems was evaluated. A detailed technical report describing the part-load and load following capability of both the pressurized fluid bed combustor and the entire pressurized fluid bed combustor/-compressed air energy storage systems is presented. The conclusions are encouraging and indicate that the open-bed PFBC/CAES power plant should provide good part-load and transient performance, and should have no major equipment-related constraints, specifically, no major problems associated with the performance or design of either the open-end PFBC or the PFBC/CAES power plant in steady-state, part-load operation are envisioned. The open-bed PFBC/CAES power plant would have a load following capability which would be responsive to electric utility requirements for a peak-load power plant. DOE

N82-27844# United Technologies Research Center, East Hartford, Conn.
TECHNICAL AND ECONOMIC ASSESSMENT OF FLUIDIZED-BED-AUGMENTED COMPRESSED AIR ENERGY-STORAGE SYSTEM. VOLUME 2: INTRODUCTION AND TECHNOLOGY ASSESSMENT
A. J. GIRAMONTI, R. D. LESSARD, D. MERRICK (Coal Processing Consultants Limited), and M. J. HOBSON (Acres American Inc.) Sep. 1981 230 p refs Prepared for Pacific Northwest Lab.
(Contract DE-AC06-77RL-01830)
(DE82-000938; PNL-3686-VOL-2) Avail: NTIS HC A11/MF A01

The results are described of a study subcontracted by PNL to the United Technologies Research Center on the engineering feasibility and economics of a CAES concept which uses a coal fired, fluidized bed combustor (FBC) to heat the air being returned from storage during the power production cycle. By burning coal instead of fuel oil, the CAES/FBC concept can completely eliminate the dependence of compressed air energy storage on petroleum fuels. A discussion of program background and an in-depth coverage of both fluid bed combustion and turbomachinery technology pertinent to their application in a CAES power plant system is presented. The CAES/FBC concept appears technically feasible and economically competitive with conventional CAES. However, significant advancement is required in FBC technology before serious commercial commitment to CAES/FBC can be realized. DOE

N82-27849# Delegationen foer Energiforskning, Stockholm (Sweden).
LONG-TERM ENERGY OPTIONS FOR SWEDEN. THE IEA MODEL AND SOME SIMULATION RESULTS
P. A. BERGENDAHL and C. BERGSTROEM 1981 261 p refs
(DE82-900916; DFE-36) Avail: NTIS (US Sales Only) HC A12/MF A01; DOE Depository Libraries

Major findings of the simulations made using the Swedish version of the MARKAL model are summarized. It is an attempt to determine what new energy supply, conversion and end-use technologies will be needed in Sweden during the next several decades, and to assess the energy contribution that can be expected from them. The reader is aquainted with the analytical approach to the planning and analysis of energy research and development programs used. An overview is given of the problem structure and analytical apparatus. DOE

N82-27851# Air Products and Chemicals, Inc., Allentown, Pa.
DEMONSTRATION OF A NITROGEN-BASED CARBURIZING ATMOSPHERE Final Report
R. J. PEARTREE Sep. 1981 140 p refs
(Contract DE-AC07-78CS-40234)
(DE82-004196; DOE/CS-40234/T2) Avail: NTIS HC A07/MF A01

A comprehensive energy study comparing nitrogen-based atmospheres to endothermic atmospheres was completed. Energy savings of up to 18.8% combined with production increases averaging 10% are possible with nitrogen-methanol carburizing atmospheres. Although the economics will vary depending on application and location, these energy savings and production increases are available to the heat treater at costs comparable to traditional endothermic atmosphere. The nitrogen-methanol atmosphere systems are controllable using all of the currently available methods of carbon control. DOE

N82-27856# Fraunhofer-Inst. fuer Systemtechnik und Innovationsforschung, Karlsruhe (West Germany).
POSSIBILITIES FOR ENERGY CONSUMPTION THROUGH MICROELECTRONICS Final Report
G. ANGERER, E. BOEHM, U. HAUSER, E. JOCHEN, W. MANNSBART, T. MENTZEL, R. DIEHL (Fraunhofer-Inst. fuer Angewandte Festkoerperphysik), M. KONSTANZER (Fraunhofer-Inst. fuer Angewandte Festkoerperphysik), A. GOETZBERGER (Fraunhofer-Inst. fuer Bauphysik), D. OSWALD (Fraunhofer-Inst. fuer Bauphysik) et al. Bonn Bundesministerium fuer Forschung und Technologie Feb. 1982 540 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-0022; ISSN-0340-7608) Avail: NTIS HC A23/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 70,50

Application of microelectronic sensors, integrated circuits, and actuators in order to control energy consuming processes and reduce energy losses was studied. The energy saving potential of microelectronics was investigated in various sectors of secondary energy consumption, i.e., heating, electrical household equipment, road traffic, business, hot water and steam generation, and use of electrical motors. Findings are based on secondary energy consumption in the Federal Republic of Germany. Results show that potential energy savings can reduce demand for primary energy by 265 to 290 billion kilowatt hours. (8% to 9% of the total demand of the Federal Republic of Germany). Author (ESA)

N82-27870# General Accounting Office, Washington, D. C. Energy and Minerals Div.
THE DEBATE OVER ACID PRECIPITATION: OPPOSING VIEWS, STATUS OF RESEARCH
11 Sep. 1981 54 p refs
(AD-A106925; GAO/EMD-81-131) Avail: NTIS HC A04/MF A01 CSCL 04B

The use of coal as a substitute for imported oil is raising concern over the possible impact of acid precipitation on the

environment and human health. Precipitation can become acidified when sulfur and nitrogen oxides emitted by fossil-fueled powerplants, vehicles, and other man-made or natural sources are chemically changed in the atmosphere and return to Earth as acid compounds. Environmental organizations and some agencies and interest groups contend that more stringent emission controls are needed immediately. On the other hand, some agencies and many industries, particularly in the coal and utility sectors, argue that much more research is needed to determine if achievable emissions reductions could significantly diminish the extent of acid precipitation, and if the benefits of such regulations would be worth their potentially high cost.
GRA

N82-27874# California Univ., Livermore. Lawrence Livermore Lab.
THREE-DIMENSIONAL, CONSERVATION EQUATION MODEL FOR SIMULATING LNG VAPOR DISPERSION IN THE ATMOSPHERE
S. T. CHAN, P. M. GRESHO, and D. L. ERMAK Sep. 1981 18 p refs
(Contract W-7405-ENG-48)
(DE82-001053; UCID-19210) Avail: NTIS HC A02/MF A01

A numerical model for simulating the vapor spread and dispersion associated with LNG releases in the atmosphere is described. The model is based on solving the set of three dimensional, time dependent, conservation equations governing incompressible flows. Spatial discretization is performed via a modified Galerkin finite element method (GFEM), and time integration is carried out via the forward Euler method (pressure is computed implicitly, however). Cost effective techniques including subcycling, mass lumping, and reduced Gauss-Legendre quadrature are discussed. Numerical results obtained by using this model are presented.
DOE

N82-28150# Johnson (E. R.) Associates, Inc., Reston, Va.
PRELIMINARY ASSESSMENT OF ALTERNATIVE DRY STORAGE METHODS FOR THE STORAGE OF COMMERCIAL SPENT NUCLEAR FUEL
Nov. 1981 230 p refs
(Contract DE-AC09-80ET-47929)
(DE82-002303; DOE/ET-47929/1) Avail: NTIS HC A11/MF A01

The results are presented for an assessment of the (1) state of technology, (2) licensability, (3) implementation schedule, and (4) costs of alternative dry methods for storage of spent fuel at a reactor location when used to supplement reactor pool storage facilities. The methods of storage that was considered included storage in casks, drywells, concrete silos and air-cooled vaults. The impact of disassembly of spent fuel and storage of consolidated fuel rods was also determined. The economic assessments were made based on the current projected storage requirements of Virginia Electric and Power Company's Surry Station for the period 1985 to 2009, which has two operating pressurized water reactors (824 MWe each). It was estimated that the unit cost for storage of spent fuel in casks would amount to $117/kgU and that such costs for storage in drywells would amount to $137/kgU. However, based on the overall assessment it was concluded both storage methods were equal in merit. Modular methods of storage were generally found to be more economic than those requiring all or most of the facilities to be constructed prior to commencement of storage operations.
DOE

N82-28221# Jorgenson (Dale W.) Associates, Cambridge, Mass.
ENERGY-ECONOMY ANALYSIS AND APPLICATION TO R AND D PLANNING Final Report, Oct. 1980 - Sep. 1981
E. A. HUDSON and P. A. DOROSH Oct. 1981 98 p
(Contract GRI-5080-310-0329)
(PB82-141128; GRI-81/0004) Avail: NTIS HC A05/MF A01
CSCL 05C

Projections of energy and economic conditions and analysis of energy economy interactions are based on a simulation model of the structure and growth of the U.S. economy (the Hudson-Jorgenson model). A reference projection is first constructed; this provides a reasonable estimate of future energy and economic conditions as well as providing information on economic growth, inflation and other variables required in project appraisal and R and D planning. Next, detailed analyses of energy economy interactions are performed; these examine the mechanisms through which energy changes affect economic structure and growth, and also provide a basis for quantitatively estimating the economic effects of specific energy changes.
GRA

02

SOLAR ENERGY

Includes solar collectors, solar cells, solar heating and cooling systems, and solar generators.

A82-28881
PURIFICATION OF RICE HULLS AS A SOURCE OF SOLAR GRADE SILICON FOR SOLAR CELLS
J. A. AMICK (Exxon Research and Engineering Co., Linden, NJ) (Electrochemical Society, Meeting, Hollywood, FL, Oct. 5-10, 1980.) Electrochemical Society, Journal, vol. 129, Apr. 1982, p. 864-866. refs

A82-29233
VARIATION OF MINORITY CARRIER LIFETIME WITH LEVEL OF INJECTION IN P-N-JUNCTION DEVICES
S. K. AGARWAL, S. C. JAIN, and S. HARSH (Solid State Physics Laboratory, Delhi, India) Electronics Letters, vol. 18, Apr. 1, 1982, p. 298, 299. refs

Minority-carrier lifetime as a function of level of injection has been measured for a number of Si and Ge p-n-junction diodes using reverse recovery and forward current-induced voltage decay methods. It is found that the lifetime always increases with injection level if the effect of the finite thickness of the base of the diode is taken into account while interpreting the experimental results. The decrease in the lifetime values reported in the literature appears to be due to erroneous interpretation of the experimental data.
(Author)

A82-29248
ELECTRODEPOSITION OF SOLAR SILICON
D. ELWELL and R. S. FEIGELSON (Stanford University, Stanford, CA) Solar Energy Materials, vol. 6, Jan.-Feb. 1982, p. 123-145. Research supported by the U.S. Department of Energy. refs

A review is presented of experimental data on the electrodeposition of silicon from molten salt and organic solutions, with emphasis on studies reported in the last three years. The potential of this method for photovoltaic applications is considered. Electrodeposition of silicon at temperatures above its melting point is a promising method of producing inexpensive silicon to be recrystallized by pulling or casting crystals. Deposition of layers onto graphite by electrowinning or electrorefining requires a relatively slow deposition rate but has the advantage of eliminating several processing steps.
(Author)

A82-29249
TEMPERATURE DEPENDENCE OF SILICON SOLAR CELL CHARACTERISTICS
N. D. ARORA and J. R. HAUSER (North Carolina State University, Raleigh, NC) Solar Energy Materials, vol. 6, Jan.-Feb. 1982, p. 151-158. Research supported by the Solar Energy Research Institute. refs

The effects of temperature on the characteristics of p-n junction solar cells are investigated theoretically. An exact numerical model of the semiconductor transport equations is used to calculate the output parameters of the cell taking into account temperature effect on the material parameters of the cell. These calculations show that the temperature coefficient of solar cell parameters such as

open-circuit voltage, short-circuit current, efficiency, etc., are typically nonlinear over the range of temperature (300-450 K) studied in agreement with the experimental results as against a constant value obtained by simple calculations. (Author)

A82-29250
SOLAR ABSORPTANCE AND THERMAL EMITTANCE OF AL2O3 FILMS ON AL - A THEORETICAL ASSESSMENT
T. S. ERIKSSON, A. HJORTSBERG, and C. G. GRANQVIST (Chalmers Tekniska Hogskola, Goteborg, Sweden) Solar Energy Materials, vol. 6, Jan.-Feb. 1982, p. 191-199. refs

Solar absorptance and thermal emittance for Al2O3 films on Al are computed by use of a previous determination of the dielectric function for evaporated Al2O3. The solar absorptance is about 0.13 for films thicker than 0.4 micron. Low thermal emittance suitable for solar thermal conversion, requires film thicknesses lower than 0.8 micron, whereas rather high emittance can be obtained for films thicker than 3 microns. Theoretical results are consistent with published experimental data. (Author)

A82-29317
PHOTOCHEMICAL ENERGY CONVERSION IN CHLOROPHYLL-CONTAINING LIPID BILAYER VESICLES
J. K. HURLEY and G. TOLLIN (Arizona, University, Tucson, AZ) Solar Energy, vol. 28, no. 3, 1982, p. 187-196. Research supported by the U.S. Department of Energy. refs

Lipid bilayer vesicles containing incorporated chlorophyll molecules are being extensively studied as potential biomimeric solar energy conversion systems based upon green plant photosynthesis. Considerable information is now available concerning the structure and excited state dynamics of these systems. Electron-transfer reactions involving the chlorophyll triplet state and donor and acceptor species have been investigated by both steady-state and transient techniques, and understanding of detailed mechanisms is beginning to emerge. Under appropriate conditions, it has been possible to achieve high degrees of conversion of excited states into energy-rich products, and energy-wasting recombinations have been considerably retarded. Most recently, mechanistic studies of vectorial electron transfer across a lipid bilayer from donor to acceptor via the chlorophyll triplet state have begun, which promise to provide a new level of insight into the factors which control energy storage efficiency in these systems. (Author)

A82-29318
ON THE CLIMATIC OPTIMIZATION OF THE TILT AND AZIMUTH OF FLAT-PLATE SOLAR COLLECTORS
C. J. WILLMOTT (Delaware, University, Newark, DE) Solar Energy, vol. 28, no. 3, 1982, p. 205-216. Research supported by the University of Delaware. refs

A82-29319
ANALYSIS OF OPEN INCLINED SURFACE SOLAR REGENERATORS FOR ABSORPTION COOLING APPLICATIONS - COMPARISON BETWEEN NUMERICAL AND ANALYTICAL MODELS
C. P. PENG (Kellog Research Center, Houston, TX) and J. R. HOWELL (Texas, University, Austin, TX) Solar Energy, vol. 28, no. 3, 1982, p. 265-268. refs

A82-29693
CHARACTERIZATION OF ELECTRON TRAPS IN N/PLUS/ INDIUM TIN OXIDE ON P-TYPE INP SOLAR CELLS
H. LIM, G. SAGNES, G. BASTIDE, L. GOUSKOV, and A. OEMRY (Montpellier II, Universite, Montpellier, France) Journal of Applied Physics, vol. 53, Apr. 1982, p. 3085-3087. refs

Deep level transient spectroscopy has been used to study main traps in n(plus)ITO/pInP solar cells. Three electron traps have been found: E1 at 320 meV (capture cross section of 10 to the -13 sq cm), E2 at 520 meV (capture cross section of 10 to the -9th sq cm), and E3 at 475 meV (capture cross section of 10 to the -13th sq cm) below the conduction band. The characteristics of levels E1 and E2 were also well observed in n-InP Schottky diode. V.L.

A82-29694* Illinois Univ., Urbana.
REDUCTION OF SOLAR CELL EFFICIENCY BY BULK DEFECTS ACROSS THE BACK-SURFACE-FIELD JUNCTION
C. T. SAH (Illinois, University, Urbana, IL), K. A. YAMAKAWA, and R. LUTWACK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Journal of Applied Physics, vol. 53, Apr. 1982, p. 3278-3290. Research supported by the U.S. Department of Energy.

The degradation of solar cell performance due to bulk defects distributed across the back-surface field junction is analyzed in terms of a three-region developed-perimeter model. Families of curves are computed and their physical significance is discussed in detail with reference to three parameters used to characterize the defects: defect area, defect density, and defect surface recombination velocity. A reduction in the open-circuit voltage due to the presence of a defect is expressed as a function of the defect area, density, cell thickness, and defect surface recombination velocity. Numerical examples are presented to illustrate the importance of the particular defect parameters. V.L.

A82-29695
BACK SURFACE FIELD AND VERTICAL SOLAR CELL
Y.-T. YANG (National Tsinghua University, Hsinchu, Republic of China) Journal of Applied Physics, vol. 53, Apr. 1982, p. 3333, 3334. refs

A light-spot traverse experiment has been performed on a pnn(+) vertical solar cell initially with a tungsten-halogen lamp and then with a monochromatic He-Ne laser beam as the light sources. It is found that the cell is characterized by relatively high ability of light-to-electric-power conversion near the high back-surface field region. Results indicate that there are two strong source regions of power conversion: one near the pn junction and the other near the nn(+) junction, near which the back-surface field exists. V.L.

A82-29696
TRANSPORT IN HYDROGENATED AMORPHOUS SILICON P-I-N SOLAR CELLS
R. S. CRANDALL (RCA Laboratories, Princeton, NJ) Journal of Applied Physics, vol. 53, Apr. 1982, p. 3350-3352. refs
(Contract XG-0-93721)

A simple model of a p-i-n structure is used to obtain solutions to the continuity equations in terms of elementary functions. In addition, a regional approximation is used to obtain a simple expression for the photocurrent. It is found that for weakly absorbed light, the shape of photocurrent-voltage curve is completely specified by the electron and hole drift lengths. Furthermore, it is the carrier with the longer drift length that determines the current-voltage curve and hence the solar cell fill factor. V.L.

A82-29790
OPTICAL FIBERS AND SOLAR ENERGY [LES FIBRES OPTIQUES ET L'ENERGIE SOLAIRE]
J. DUGAS, J.-M. CARIOU, and L. MARTIN (Toulouse III, Universite, Toulouse, France) L'Aeronautique et l'Astronautique, no. 92, 1982, p.57-61. In French.

The possibilities for the use of optical fibers for the transmission of solar energy from the focus of a solar concentrator to a device for solar energy utilization are considered. The transmittance properties of currently available optical fibers are shown to be suitable for solar energy transmission, and a device for the coupling of focused solar energy into an optical fiber is presented which is based on the use of a mirror providing an image of the sun coinciding with the entrance end of a single light conductor. The integration of many such modules, each with a maximum output power of about 2W, may be used in applications such as solar furnaces for hydrogen production, photovoltaic energy conversion or thermal electricity generation. A.L.W.

A82-30057
HIGH-EFFICIENCY SILICON SOLAR CELLS AND PROSPECTS FOR THEIR IMPROVEMENT [VYSOKOEFFEKTIVNYE KREMNIEVYE FOTOPREOBRAZOVATELI I PERSPEKTIVY IKH SOVERSHENSTVOVANIIA]
N. M. BORDINA, G. M. GRIGOREVA, G. S. DALETSKII, E. V. ZHIDKOVA, and A. K. ZAITSEVA (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) Geliotekhnika, no. 1, 1982, p. 3-7. In Russian. refs

The current status of the design of high-efficiency silicon solar cells is briefly reviewed, and the prospects for the improvement of the efficiency of such cells are assessed. Particular consideration is given to the advantages of cells with n(+)-p-p(+) structure, thin-base cells, and cells with p-i-n structure. B.J.

A82-30058
NUMERICAL SOLUTION OF THE ONE-DIMENSIONAL BOUNDARY VALUE PROBLEM OF CHARGE TRANSFER IN SOLAR-CELL ELEMENTS [CHISLENNOE RESHENIE ODNOMERNOI KRAEVOI ZADACHI PERENOSA ZARIADA V SOLNECHNYKH ELEMENTAKH]
N. M. BOGATOV, L. I. GROMOVOI, M. B. ZAKS, and E. V. LELIUKH Geliotekhnika, no. 1, 1982, p. 7-14. In Russian. refs

The paper presents an algorithm for the numerical solution of the Shockley-model equations with the additional condition of electroneutrality. As an illustration, the method is used to determine the volt-ampere characteristics of an n(+)-p silicon solar-cell element. B.J.

A82-30059
THE EFFECT OF THE INTERMEDIATE LAYER ON THE CHARACTERISTICS OF SCHOTTKY-BARRIER SOLAR-CELL ELEMENTS [VLIIANIE PROMEZHUTOCHNOGO SLOIA NA KHARAKTERISTIKI SOLNECHNYKH ELEMENTOV S BAR'EROM SHOTTKI]
O. S. ZINETS, S. S. KILCHITSKAIA, and V. I. STRIKHA (Kievskii Gosudarstvennyi Universitet, Kiev, Ukrainian SSR) Geliotekhnika, no. 1, 1982, p. 15-19. In Russian. refs

The diode-theory approximation is used to obtain analytic expressions for the short-circuit current and open-circuit voltage of Schottky-barrier solar-cell elements with a thin intermediate layer. Formulas are presented which take into account various conditions of charge transfer into the metal as well as recombination losses in the quasi-neutral region. A numerical analysis is presented of the dependences of short-circuit current, open-circuit voltage, and efficiency on the thickness of the intermediate layer for the case of silicon at AM0. It is found that there is an optimal thickness of the intermediate layer at which the efficiency is maximal. B.J.

A82-30060
SOLAR POWER STATIONS - HEAT TRANSFER AND THERMAL OPTIMIZATION IN THE PRODUCTION OF SATURATED WATER VAPOR [SOLNECHNYE ENERGETICHESKIE STANTSII - TEPLOOBMEN I TEPLOVAIA OPTIMIZATSIIA PRI GENERIROVANII NASYSHCHENNOGO VODIANOGO PARA]
D. I. TEPLIAKOV and R. R. APARISI (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) Geliotekhnika, no. 1, 1982, p. 23-30. In Russian. refs

A82-30061
INVESTIGATION OF MIRROR CONCENTRATORS INTENDED FOR OPERATION WITH HIGH-CURRENT SOLAR CELLS [ISSLEDOVANIE ZERKAL'NYKH KONTSENTRATOROV, PREDNAZNACHENNYKH DLIA RABOTY S SIL'NOTOCHNYMI SOLNECHNYMI ELEMENTAMI]
A. K. ALIMOV, M. U. USMANOV, G. IA. UMAROV, KH. K. ARIPOV, V. R. LARIONOV, and V. D. RUMIANTSEV (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR; Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR) Geliotekhnika, no. 1, 1982, p. 35-37. In Russian. refs

An analysis is presented of the concentration properties of circular parabolic mirrors made of sheet glass with a diameter of 500 mm. The unit cost of these mirrors is assessed in the case of their use with high-current nGaAs-pGaAs-p(+)AlGaAs heterojunction solar cells. Test results show these mirrors to be cost effective with respect to electrical power generation. B.J.

A82-30062
A METHOD FOR CALCULATING THE RADIANT ENERGY INCIDENT ON A VAPOR GENERATOR IN A SOLAR POWER STATION [METOD RASCHETA LUCHISTOI ENERGII, PADAIUSHCHEI NA POVERKHNOSTI PAROGENERATORA SES]
S. BATMUNKH Geliotekhnika, no. 1, 1982, p. 42-47. In Russian.

An algorithm is developed for calculating the distribution of radiant fluxes along the perimeter of a solar vapor generator (SVG), the mean value of the utilization coefficient of the mirror surface, and the total value of radiant fluxes on the SVG in the course of a day. The method is used to calculate the aforementioned parameters for a tower-type solar power station located in the Crimea for the months of June, September, and December. B.J.

A82-30327
AMERICAN VACUUM SOCIETY, NATIONAL SYMPOSIUM, 28TH, ANAHEIM, CA, NOVEMBER 2-6, 1981, PROCEEDINGS. PARTS 1 & 2
Journal of Vacuum Science and Technology, vol. 20, Mar.; Apr. 1982. 703 p.; 546 p.

Among the vacuum technology topics considered are thin-film photovoltaics, energy-related optical coatings, coatings and surfaces with specific properties, the deposition, characterization and diagnostics of thin films, grain boundaries and adhesion, critical aspects of semiconductor device processing, the effects of ion bombardment on surfaces, chemisorption and catalysis, electronic excitations and stimulated desorption, and surface vibrational spectroscopy. Also discussed are the dynamics of molecule-surface interactions, surface electronic structure, interface electronics and geometric structures, Schottky barrier formation and silicide interfaces, the growth and structure of interfaces, epitaxial growth, laser and electron beam processing, oxide-semiconductor interfaces, the atomic and electronic structure of semiconductor surfaces, and microlithography. O.C.

A82-30328
POLYCRYSTALLINE THIN FILMS FOR TERRESTRIAL SOLAR CELLS
A. ROTHWARF (Drexel University, Philadelphia, PA) Journal of Vacuum Science and Technology, vol. 20, Mar. 1982, p. 282-289. refs

The development of polycrystalline thin film solar cells for terrestrial use is reviewed. The topics covered include economic aspects, efficiency, lifetime, range of materials, operation and structure of the cells, thin film effects related to surfaces, grain boundaries and interfaces, deposition and post deposition effects, stability, process sensitivity, and substrate requirements. The status of the leading thin film materials is presented. (Author)

A82-30329
AMORPHOUS THIN FILMS FOR TERRESTRIAL SOLAR CELLS
D. E. CARLSON (RCA Laboratories, Princeton, NJ) Journal of Vacuum Science and Technology, vol. 20, Mar. 1982, p. 290-295. Research supported by RCA refs
(Contract EY-76-C-03-1286; XJ-9-8254; XG-0-9372-1)

Progress in amorphous semiconductor solar cell technology at RCA Laboratories and other research organizations is reviewed. The performance of cells is discussed for homojunction p-i-n structures and structures utilizing hydrogenated amorphous alloys of Si-C, Si-F, Si-Ge, and B-Si. Recently, several organizations have reported conversion efficiencies in the range of 6.0%-7.5% for homojunction p-i-n cells and structures using alloys of Si-C-H and Si-F-H. The effects of various impurities on solar-cell performance are discussed. Data on the diffusion of various contact materials and dopants in amorphous Si at elevated temperatures are also presented. (Author)

A82-30861
SOLAR GRADE SILICON AS A POTENTIAL CANDIDATE MATERIAL FOR LOW-COST TERRESTRIAL SOLAR CELLS
S. PIZZINI (Milano, Universita; Heliosil S.p.A., Milan, Italy) Solar Energy Materials, vol. 6, Mar.-Apr. 1982, p. 253-297. refs

The present status of conventional and advanced silicon production processes is examined in order to discuss their suitability as sources of low cost silicon feedstocks for photovoltaic application. This discussion supports the view that only methods based on advanced Siemens technology and upgrading metallurgical silicon seem practical candidates for producing silicon feedstocks for solar use, albeit upgraded MG silicon needs some yet ill-defined intermediate purification step to be transformed to a solar grade material. (Author)

A82-30862
HYDROGENATED AMORPHOUS SILICON CARBIDE AS A WINDOW MATERIAL FOR HIGH EFFICIENCY A-SI SOLAR CELLS
Y. TAWADA, H. OKAMOTO, and Y. HAMAKAWA (Osaka University, Toyonaka, Japan) Solar Energy Materials, vol. 6, Mar.-Apr. 1982, p. 299-315. Research sponsored by the Ministry of Education and Agency of Industrial Science and Technology. refs

A82-30863
A PHOTOELECTROCHEMICAL CELL BASED ON CHEMICALLY DEPOSITED SB2SE3 THIN FILM ELECTRODE AND DEPENDENCE OF DEPOSITION ON VARIOUS PARAMETERS
R. N. BHATTACHARYA and P. PRAMANIK (Indian Institute of Technology, Kharagpur, India) Solar Energy Materials, vol. 6, Mar.-Apr. 1982, p. 317-322. Research supported by the Council of Scientific and Industrial Research. refs

The photoelectrochemical behavior of chemically deposited Sb2Se3 thin film in aqueous solution is studied. The short-circuit photocurrent is about 0.45 mA/sq cm and open-circuit photovoltage is about 0.37 V. This paper also describes the dependence of the deposition on pH, temperature and deposition mixture. (Author)

A82-30865
FURTHER STUDIES OF THE PHOTOELECTROCHEMICAL PROPERTIES OF THE GROUP VI TRANSITION METAL DICHALCOGENIDES
G. KLINE, K. K. KAM, R. ZIEGLER (U.S. Department of Energy, Ames Laboratory, Ames, IA), and B. A. PARKINSON (Solar Energy Research Institute, Golden, CO) Solar Energy Materials, vol. 6, Mar.-Apr. 1982, p. 337-350. refs
(Contract W-7405-ENG-82; XP-9-98198-1)

The photoelectrochemical behavior of synthetic crystals of WS2, MoS2 and crystals with mixed metal and chalcogen composition was studied and compared with the behavior of MoSe2 and WSe2. The composition and stoichiometry of the crystals and the composition of the electrolyte are varied and the behavior of the materials in a regenerative liquid junction solar cell is measured and analyzed. The quantum yields as a function of wavelength and photon flux are investigated and sunlight to electricity conversion efficiencies are measured. The formation of iodine layers on the photoelectrode surface under high illumination intensity was observed and discussed with respect to the use of these materials with solar concentrators. (Author)

A82-31098
DAILY EFFICIENCY OF SOLAR COLLECTORS
B. BARTOLI, V. CUOMO, M. FRANCESCA, C. SERIO (Napoli, Universita, Naples, Italy), G. BARONE, and P. MATTARELLI (SoGesTA, Urbino, Italy) Applied Energy, vol. 10, Mar. 1982, p. 169-202. refs

It is shown that the daily efficiency of flat-plate solar collectors working at constant flow rate can be evaluated with a simple algorithm when their structural features are known. It is also shown that long-term performances can be calculated starting from monthly values of global radiation. (Author)

A82-31099
ENHANCEMENT OF CONCENTRATION USING SIMPLE MULTI-PLANE MIRRORS
J. K. SHARMA, A. DANG, and H. P. GARG (Indian Institute of Technology, New Delhi, India) Applied Energy, vol. 10, Mar. 1982, p. 233-242. refs

A numerical analysis for the concentration ratio of a tracking/nontracking solar concentrator made of plane mirrors is presented. The mirrors are assumed to be specular and nonabsorbing, and the concentration ratio with different mirror angles is considered, taking into account the acceptance angle. The concentration ratio was found to be maximized with an acceptance angle of 25 deg, and increased with increasing numbers of mirrors. The concentration tends toward that of a compound parabolic reflector. Efficient operation with concentration above 20 is noted to require tracking. M.S.K.

A82-31187
PHOTOVOLTAIC EFFECTS IN CU2O-CU SOLAR CELLS GROWN BY ANODIC OXIDATION
E. FORTIN and D. MASSON (Ottawa, University, Ottawa, Canada) Solid-State Electronics, vol. 25, Apr. 1982, p. 281-283. refs

Thin Cu2O-Cu photovoltaic cells grown by anodic oxidation of Cu in an alkaline solution at T = 86 C give an open-circuit voltage of up to 400 mV and a short-circuit current density of up to 0.6 mA/sq cm under AM1 illumination. The cells display charge storage properties as well; that is, a small fraction of the solar energy can be stored and given back by the cells in the dark. (Author)

A82-31207
PARAMETRIC PHOTOVOLTAIC CELL
G. DE MEY (Gent, Rijksuniversiteit, Ghent, Belgium) Electronics Letters, vol. 18, Apr. 15, 1982, p. 334-336.

A new way of converting light energy into electric power is presented. A capacitor is charged periodically under influence of the chopped light flux. Electric energy stored in the capacitor can be increased by the parametric effect, i.e. the reduction of the capacitance value. The energy conversion process is analysed. The possible applications and limitations of this device are indicated and discussed. (Author)

A82-31440
SPECTRAL SELECTIVITY OF NICKEL AND CHROMIUM ROUGH SURFACES
R. T. KIVAISI and L. STENSLAND (Institute of Optical Research, Stockholm, Sweden) Applied Physics A - Solids and Surfaces, vol. A27, Apr. 1982, p. 233-238. Research supported by the Swedish Institute. refs

The reflectance of metal surfaces with sinusoidal roughness of different periods and depths has been investigated experimentally. The results show clearly that the surface structure can be used to modify the optical properties of metal surfaces at different wavelengths. With a proper choice of groove depth to period ratio, nickel or chromium coatings on gratings have low reflectance in the short wavelength region, but achieve high reflectance in the infrared region. A solar absorptance as high as 93% has been obtained from such a surface. The surfaces are thought to be representative for randomly rough surfaces provided proper correlation length and height variation are chosen. Further, as the absorber is made of a single metal surface, it could be highly temperature resistant. (Author)

A82-31492
AN OPTICAL HELIOSTAT FOR SOLAR POWER STATIONS [OPTICHESKII GELIOSTAT DLIA SES]
L. BERRIS and E. S. AVANESOV (Akademiia Nauk Turkmenskoi SSR, Nauchno-Proizvodstvennoe Ob'edinenie Solntse, Turkmen SSR) Akademiia Nauk Turkmenskoi SSR, Izvestiia, Seriia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk, no. 1, 1982, p. 40-44. In Russian.

A82-31568
USE OF SOLAR FURNACES. II - THERMOPHYSICAL PROPERTIES
D. SURESH, W. W. S. CHARTERS (Melbourne, University, Parkville, Victoria, Australia), and P. K. ROHATGI (Council of Scientific and Industrial Research, Regional Research Laboratory, Bhopal, India) Solar Energy, vol. 28, no. 4, 1982, p. 273-280. refs

The various ways in which solar furnaces have been used to measure the high-temperature thermophysical properties of materials are reviewed, with attention given to the advantages and disadvantages of these furnaces. Thermal expansion experiments are seen as lacking accuracy. By introducing homogeneous heating methods, as well as precision dilatometers, this defect could be overcome. Solar furnaces must be designed so as to give larger focal areas of uniform flux density. Modifying the pulsed method so as to eliminate the requirement for homogeneity of the energy flux is thought desirable. It would also be worthwhile to design a suitable loading device to obviate complications arising out of elongation of the specimen during tests. C.R.

A82-31571
POSSIBLE APPLICATIONS OF LARGE SOLAR ARRAYS IN ASTRONOMY AND ASTROPHYSICS
S. DANAHER, D. J. FEGAN, N. A. PORTER (University College, Dublin, Ireland), T. C. WEEKES (Mount Hopkins Observatory, Amado, AZ), and T. COLE (Ford Motor Co., Dearborn, MI) Solar Energy, vol. 28, no. 4, 1982, p. 335-343. Research supported by the National Board of Science and Technology of Ireland. refs

It is pointed out that the large collection area of solar test facilities may be useful in certain astronomical experiments. Since only nighttime hours would be involved, there would be no conflict with daytime solar research. Although solar concentrators are optically crude by conventional astronomical telescope standards, there are certain applications where angular resolutions of 0.25 deg can be tolerated. These applications are discussed, along with results from the nighttime use of large concentrators. A table comparing the parameters of a typical astronomical telescope with those of a typical solar concentrator is included. Four areas of astronomical research where solar concentrators might be useful are discussed. They are the detection of Cerenkov light from extensive air showers, optical bursts, optical detection of meteors, and stellar photometry. C.R.

A82-31856#
SATELLITE THERMAL DESIGN AND ANALYSES FOR TITAN 34D/IUS AND STS/IUS LAUNCH VEHICLE ENVIRONMENTS
H. FACTOR and E. A. STIPANDIC (General Electric Co., Space Div., Valley Forge, PA) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 8 p.
(AIAA PAPER 82-0828)

T34D/IUS launch vehicle studies are considered, taking into account heater power studies for a cold mission and solar array studies. A description of STS/IUS studies is also provided. Solar array high temperature problems were identified by examining in detail the worst case attitudes/timelines for each mission phase. Parametric study results produced limiting vehicle attitudes and timelines. This data was then used to establish launch window constraints. It was found that the spacecraft heater power circuitry design was not adequate for an STS launch because both peak and average heater power requirements were exceeded. A separate heater electrical bus and a method of switching to different circuits was incorporated. For the Titan launch, a tighter launch pad environmental control was found to be necessary to limit prelaunch heater power usage and to satisfy the spacecraft battery state-of-charge requirements. G.R.

A82-31879*# North Carolina State Univ., Raleigh.
CONVERSION OF BLACKBODY RADIATION INTO LASER ENERGY
R. M. MCINVILLE and H. A. HASSAN (North Carolina State University, Raleigh, NC) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 6 p. refs
(Contract NCC1-54)
(AIAA PAPER 82-0871)

By employing detailed kinetic models, three concepts which utilize a blackbody cavity for the conversion of solar energy into laser energy using a CO2 lasant are analyzed and compared. In the first, the blackbody radiation is used to excite flowing CO2 directly. The second and third employ a mixing laser concept with CO and N2 being the donor gases. The CO is optically pumped while thermal heating excites the N2. Blackbody temperatures ranging from 1500 deg K - 2500 deg K are considered. Based on calculated laser power output per unit flow rate of CO2, it appears that the N2-CO2 mixing laser is the most attractive system. (Author)

A82-31984*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOLAR-POWERED AIRPLANE DESIGN FOR LONG-ENDURANCE, HIGH-ALTITUDE FLIGHT
J. W. YOUNGBLOOD and T. A. TALAY (NASA, Langley Research Center, Space Systems Div., Hampton, VA) American Institute of Aeronautics and Astronautics, International Very Large Vehicles Conference, 2nd, Washington, DC, May 17, 18, 1982, 10 p. refs
(AIAA PAPER 82-0811)

This paper describes the performance analysis and design of a solar-powered airplane for long-endurance, unmanned, high-altitude cruise flight utilizing electric propulsion and solar energy collection/storage devices. For a fixed calendar date and geocentric latitude, the daily energy balance, airplane sizing, and airplane aerodynamics relations combine to determine airplane size and geometry to meet mission requirements. Vehicle component weight loadings, aerodynamic parameters, and current and projected values of power train component characteristics form the basis of the solution. For a specified mission, a candidate airplane design is presented to demonstrate the feasibility of solar-powered long endurance flight. Parametric data are presented to illustrate the airplane's mission flexibility. (Author)

A82-32183
DETERMINATION OF THE GRAIN BOUNDARY RECOMBINATION VELOCITY IN POLYCRYSTALLINE SILICON AS A FUNCTION OF ILLUMINATION FROM PHOTOCONDUCTANCE MEASUREMENTS
P. PANAYOTATOS, E. S. YANG, and W. HWANG (Columbia University, New York, NY) Solid-State Electronics, vol. 25, May 1982, p. 417-422. refs
(Contract XW-1-1272-1; DAAG29-79-C-0079)

A82-32543
THICK OPTICAL FILMS FOR THE CONDUCTION OF OPTICAL AND INFRARED RADIATION
C. N. BAIN, B. A. GORDON, T. M. KNASEL, and R. L. MALINOWSKI (Science Applications, Inc., McLean, VA) In: Los Alamos Conference on Optics '81, 2nd, Los Alamos, NM, April 7-10, 1981, Proceedings. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p. 25-32. refs

Experimental results are presented for the characteristics of thick optical films, which can be used to direct and conduct optical and IR radiation, for the case of light concentration onto solar cells. Incident light is trapped within a thin, flat sheet of transparent material by a diffuse selective surface on the back of the transparent layer, and so directed that total internal reflection occurs, with some of the captured light finding its way back to the photovoltaic cells attached to the back of the layer. A Monte Carlo computer model is used to analyze this system, whose

achievable gain depends on layer thickness, trapping material refraction index, and solar cell shape and size. Results indicate that gains of a factor of two in power output are obtainable for the case of sparsely-packed solar cell arrays and lower factors for more densely-packed arrays. O.C.

A82-32546
CONCENTRATION OF A CASSEGRAIN SOLAR FURNACE
M. H. COBBLE (New Mexico State University, Las Cruces, NM) In: Los Alamos Conference on Optics '81, 2nd, Los Alamos, NM, April 7-10, 1981, Proceedings. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p. 46-53.

A solar furnace comprising a paraboloidal mirror for tracking the sun and a hyperboloidal reflector having one focus in common with the paraboloid is analyzed to determine the geometric concentration of the system. A numerical ray-trace analysis was carried out to study various geometrical configurations of the two reflectors. In particular, the geometric concentration is calculated for the case when the line joining the foci of the hyperboloid and the axis of revolution of the paraboloid are not coincident. (Author)

A82-32570#
OPTICAL CHARACTERIZATION METHOD FOR CONCENTRATING SOLAR COLLECTORS USING REVERSE ILLUMINATION
K. MASTERSON (Solar Energy Research Institute, Golden, CO) and H. GAUL (Solar Innovations, Inc., Boulder, CO) In: Los Alamos Conference on Optics '81, 2nd, Los Alamos, NM, April 7-10, 1981, Proceedings. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p. 498-504. Research supported by the U.S. Department of Energy. refs

The reverse illumination optical method, by means of which solar concentrator overall alignment and aligning elements are checked, areas of extreme distortion are identified, and receiver intercept factors are determined, involves viewing the concentrator on its optical axis and through a telescope located several kilometers away. The method is simpler and less expensive than ray tracing, but does not detail the magnitude and direction of slope errors. Portions of the concentrator aperture not filled by the image of a high visibility target are ineffective in concentrating the sun's energy on a receiver of the same dimensions as the target. Image analysis of these records yields a quantitative measure of reflector alignment and intercept factor for the collector. O.C.

A82-32693
DISTRIBUTED SERIES RESISTANCE EFFECTS IN SOLAR CELLS
L. D. NIELSEN (Danmarks Tekniske Hojskole, Lyngby, Denmark) IEEE Transactions on Electron Devices, vol. ED-29, May 1982, p. 821-827. Commission of the European Communities refs
(Contract CEC-ESC-R-020-DK(G))

A mathematical treatment is presented of the effects of one-dimensional distributed series resistance in solar cells. A general perturbation theory is developed, including consistently the induced spatial variation of diode current density and leading to a first-order equivalent lumped resistance of one third the total sheet resistance. For the case of diode characteristics of exponential type and distributed resistance of arbitrary size, unified numerical results are presented for both illuminated and dark characteristics. At high forward dark currents, the distributed series resistance is shown to cause an effective doubling of the 'diode quality factor'. (Author)

A82-32696* Illinois Univ., Urbana.
EFFECT OF THICKNESS ON SILICON SOLAR CELL EFFICIENCY
C.-T. SAH (Illinois, University, Urbana, IL), K. A. YAMAKAWA, and R. LUTWACK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IEEE Transactions on Electron Devices, vol. ED-29, May 1982, p. 903-908. Research supported by the U.S. Department of Energy and NASA. refs

A computer-aided-design study on the dependence of the efficiency peak of a back-surface field solar cell on the concentrations of the recombination and dopant impurities is presented. The illuminated current-voltage characteristics of more than 100 cell designs are obtained using the transmission line circuit model to numerically solve the Shockley equations. Using an AM 1 efficiency of 17% as a target value, it is shown that the efficiency versus thickness dependence has a broad maximum which varies by less than 1% over more than a three-to-one range of cell thicknesses from 30 to 100 microns. An optically reflecting back surface will give only a slight improvement of AM 1 efficiency, about 0.7%, in this thickness range. Attention is given to the dependence of the efficiency on patchiness across the back-surface field low-high junction in thin cells. C.R.

A82-32691
EFFICIENCY OF HOT-CARRIER SOLAR ENERGY CONVERTERS
R. T. ROSS (Ohio State University, Columbus, OH) and A. J. NOZIK (Solar Energy Research Institute, Golden, CO) Journal of Applied Physics, vol. 53, May 1982, p. 3813-3818. refs
(Contract EG-77-C-01-4042)

A single-threshold quantum-utilizing device with hot electronic bands is reported whose solar energy conversion efficiency exceeds the efficiency of an ideal fully thermalized device. In the proposed hot-carrier flat-plate device, the excited carriers thermally equilibrate among themselves, but not with the environment. When operated under typical terrestrial conditions (AM 1.5 illumination at 300 K), the new device can convert solar energy with an efficiency of 66%, as compared with maximum efficiencies of 33% for a quantum device operating at thermal equilibrium and 52% for an ideal thermal conversion device. This is achieved due to a high Carnot efficiency resulting from a high effective absorber temperature and due to a negative potential difference between the bands leading to a reduction in reradiation from the absorber. V.L.

A82-32692
FREQUENCY DEPENDENT CAPACITANCE STUDIES OF THE CDS/CU2S THIN-FILM SOLAR CELL
L. V. HMURCIK (Clarkson College of Technology, Potsdam, NY) and R. A. SERWAY (James Madison University, Harrisonburg, VA) Journal of Applied Physics, vol. 53, May 1982, p. 3830-3838. refs
(Contract DE-AC01-79ET-23110)

The dark capacitance of CdS cells has been measured as a function of both bias voltage and operating signal frequency. Results indicate a frequency dependence of the dark current capacitance which can be attributed to deep trapping states in the bulk CdS and at the interface; these states can be characterized by a time constant in the simple relaxation model. Photocapacitance measurements indicate that hole trapping takes place in a narrow region of the i layer near the Cu2S/CdS junction. The results are interpreted in terms of a frequency-dependent model proposed by Schibli and Milnes (1968). It is shown that the simple planar junction model commonly used to describe the CdS cell is accurate at high frequencies. V.L.

A82-32893
DEEP TRAP LEVELS IN CDS SOLAR CELLS OBSERVED BY CAPACITANCE MEASUREMENTS
L. HMURCIK (Clarkson College of Technology, Potsdam, NY), L. KETELSEN (Illinois, University, Urbana, IL), and R. A. SERWAY (James Madison University, Harrisonburg, VA) Journal of Applied Physics, vol. 53, May 1982, p. 3839-3847. refs
(Contract DE-AC01-79ET-23110)

Capacitance measurements have been carried out as a function of reverse bias voltage and signal frequency on thin-film and single-crystal CdS solar cells. It is shown that such measurements can reveal abrupt changes in C-V plots which are attributed to the presence of deep trapping states. The anomalous change in capacitance occurs when the bias voltage raises a trapping state above the Fermi level; the strength of the anomalies depends on several factors including temperature, signal frequency, and junction properties. Measurements taken on the CdS cells indicate that at least two deep trapping states are present in the partially formed i layer of CdS, which is consistent with results reported by other workers. V.L.

A82-32894
TEMPERATURE COEFFICIENTS OF THE OPEN-CIRCUIT VOLTAGE OF P-N JUNCTION SOLAR CELLS
C.-Y. WU and J.-F. CHEN (National Chiao Tung University, Hsinchu, Republic of China) Journal of Applied Physics, vol. 53, May 1982, p. 3852-3858. refs

An analytical expression is derived for the temperature coefficient of the open-circuit voltage of p-n junction solar cells with various structures. Simplified expressions for the temperature coefficient, directly applicable to conventional p-n junction and BSF solar cells, are then obtained for two special cases: (1) the saturation dark current is mainly contributed from the base and (2) the saturation dark current is mainly contributed from the emitter. It is shown that the temperature coefficient of the open-circuit voltage is largely determined by the solar cell structure, the value of the open-circuit voltage, and the effective energy-gap narrowing in the heavily doped layer. Based on the temperature coefficient, the effectiveness of a high-low junction in BSF solar cell can be evaluated; the temperature coefficient of the open-circuit voltage of a BSF cell fabricated on a thin epitaxial substrate can be also used to measure the effective energy-gap narrowing in the highly doped emitter. V.L.

A82-32895
AN EFFECT OF BACK-SURFACE BORON IMPLANTATION ON SILICON SOLAR CELLS
M. B. SPITZER, S. J. SOLOMON, and P. R. YOUNGER (Spire Corp., Bedford, MA) Journal of Applied Physics, vol. 53, May 1982, p. 3926. refs

An experimental study has been carried out to investigate mechanisms responsible for the effect of open-circuit voltage enhancement in back-surface ion-implanted silicon solar cells. It is shown that open-circuit voltage enhancement in boron-implanted cells is due to a back-surface field effect, whereas gettering, if present, does not affect cell performance. This result is consistent with the observation that, for equal fluence, the damage produced by boron implantation is less than that produced by heavier ions, and, consequently, boron-implant damage is less effective as a gettering treatment for the implant and anneal conditions reported. V.L.

A82-33022
COMPARISON OF FRESNEL LENSES AND PARABOLIC MIRRORS AS SOLAR ENERGY CONCENTRATORS
E. LORENZO and A. LUQUE (Escuela Tecnica Superior de Ingenieros de Telecomunicacion, Madrid, Spain) Applied Optics, vol. 21, May 15, 1982, p. 1851-1853. Research sponsored by the Ministerio de Industria. refs

A82-33255
ENERGY CONVERSION PROCESS OF P-I-N AMORPHOUS SI SOLAR CELLS
Y. KUWANO, S. TSUDA, and M. OHNISHI (Sanyo Electric Co., Ltd., Research Center, Hirakata, Osaka, Japan) Japanese Journal of Applied Physics, Part 1, vol. 21, Feb. 1982, p. 235-241. Research supported by the Agency of Industrial Science and Technology. refs

The photovoltaic conversion process of a p-i-n amorphous silicon (a-Si) solar cell is investigated, and its theoretical limit efficiency is calculated. Under AM-1 illumination, the theoretical limit efficiency of the p-i-n a-Si solar cell is estimated to be 12.5%, while that under fluorescent lamp illumination is estimated to be 25.9%. In the calculation of the charge distribution in a-Si film, the Shifted U distribution is proposed for the distribution function of gap states. Poisson's equation is directly solved as a boundary condition problem, and the output characteristics of the p-i-n a-Si solar cell are calculated by solving the continuity equation for the photo-generated carriers. (Author)

A82-33546
THE SOLAR POWER SATELLITE [SATELLITE DE PUISSANCE SOLAIRE]
P. F. COMBES (Toulouse III, Universite, Toulouse, France) L'Aeronautique et l'Astronautique, no. 93, 1982, p. 62-77. In French. refs
(ONERA, TP NO. 1982-52)

The construction, launch, components, and operations of satellite solar power systems (SSPS) for direct beaming of solar energy converted to electricity to earth stations are outlined. The reference designs of either Si or concentrator GaAs solar cell assemblies large enough to project 5 GW of power are described. The beam will be furnished by klystrons or amplitrons for reception by rectennas on earth. Conforming to the law of amplitude and the equiphase law will permit high efficiencies, pointing accuracy, and low power deposition/sq cm, thus avoiding environmental problems, although some telecommunications systems may suffer interference. The construction of the dipole rectenna grid is sketched, noting that one receiver would be an ellipse sized at 10 x 13 km. Various forms of pollution which could result from the construction of an SSPS are examined. M.S.K.

A82-33683
EFFICIENT CDSE/P/+/N SI TUNNEL JUNCTION PHOTOANODE FOR SOLAR CELL
W. E. PINSON (Infrared Photo, Ltd., Ottawa, Canada) Applied Physics Letters, vol. 40, June 1, 1982, p. 970-972. refs

The 1.03-V solar photoemf generated by this CdSe/p/+/n Si photoanode lends itself to solar storage applications. Evidence is presented that the 21-mA/sq cm short circuit solar photocurrent results from a low resistance tunnel path between the CdSe conduction band and the p/+/ Si valence band. The dark electron current is used to calculate that the hole quasi-Fermi level at the CdSe surface of the solar illuminated open circuited photoanode lies 0.16 V below the CdSe corrosion potential. Hence, even on open circuit the CdSe surface of the illuminated photoanode will corrode. (Author)

A82-33685* Spire Corp., Bedford, Mass.
NON-MASS-ANALYZED ION IMPLANTATION FROM A SOLID PHOSPHORUS SOURCE
M. B. SPITZER and S. N. BUNKER (Spire Corp., Bedford, MA) Applied Physics Letters, vol. 40, June 1, 1982, p. 976-978. refs
(Contract NAS7-100)

A phosphorus ion beam, extracted from a Freeman ion source charged with elemental phosphorus, has been investigated for use in solar cell fabrication. Mass spectroscopy of the beam indicates the absence of both minority-carrier lifetime degrading impurities and hydrogen. The ion beam, without mass analysis, was used for ion implantation of solar cells, and performance for all cells was found to be equivalent to mass-analyzed controls. (Author)

A82-33686
HIGH CURRENT POST-HYDROGENATED CHEMICAL VAPOR DEPOSITED AMORPHOUS SILICON P-I-N DIODES
N. SZYDLO, E. CHARTIER, N. PROUST, J. MAGARINO, and D. KAPLAN (Thomson-CSF, Laboratoire Central de Recherches, Orsay, Essonne, France) Applied Physics Letters, vol. 40, June 1, 1982, p. 968-990. Research supported by the Commissariat a l'Energie Solaire. refs

The fabrication of amorphous Si p-i-n diodes by means of chemical vapor deposition and post-hydrogenation in a hydrogen plasma has been demonstrated. Current densities of up to 50 A/sq cm, rectification ratios better than 10 million for 3-V applied bias, and a characteristic reversible breadown voltage of up to about 20 V, are observed through analysis of current-voltage characteristics. Results are compared with those obtained for the case of SiH4 glow discharge decomposition-prepared amorphous Si p-i-n diodes. O.C.

A82-33714#
BIAXIAL CYCLIC DEFORMATION AND CREEP-FATIGUE BEHAVIOR OF MATERIALS FOR SOLAR THERMAL SYSTEMS
S. MAJUMDAR (Argonne National Laboratory, Argonne, IL) ASME, Transactions, Journal of Pressure Vessel Technology, vol. 104, May 1982, p. 88-95. Research supported by the U.S. Department of Energy. refs
(ASME PAPER 82-PVP-74)

A82-33895#
SOLAR BACTERIAL BIOMASS FARM FOR SPACE VEHICLES
H. TRIBUTSCH (Berlin, Freie Universitaet, Berlin, West Germany) Astronautics and Aeronautics, vol. 20, June 1982, p. 66-68. refs

The use of the bacterium Thiobacillus ferrooxidans to produce biomass ten times as efficiently as the best agricultural land is discussed. A solution of Fe(2+), carbon dioxide from the air, and oxygen is all that the bacterium needs to grow and multiply and produce biomass at 35 percent efficiency. Depending on what process is used to manufacture the Fe(2+), the final efficiency would range from 6 to 17.7 percent, compared to the 1 percent efficiency of photosynthesis. A solar farm in space producing biomass by means of a continuous-flow apparatus is described. The bacterium has characteristics suitable for living in outer space: ability to grow in the dark, toleration of harsh living conditions, and resistance to radiation. C.D.

A82-33925#
SOLAR HEAT COLLECTOR-GENERATOR FOR COOLING PURPOSES
K. ABDULLAH (Bogor Agricultural University, Bogor, Indonesia) Regional Journal of Energy Heat and Mass Transfer, vol. 4, Jan. 1982, p. 19-26; Discussion, p. 26, 27.

The performance of an experimental LiBr-H2O solar collector powered absorption cooling system is described. A numerical model was developed of the energy, mass, and momentum balances across the heat-exchange loop to obtain the refrigerant vapor generation rate. The mechanism works by the thermosiphon principle, which eliminates mechanical devices from the loop. All leaks were fixed before measurements began with a test apparatus comprising a pyrex tube 1.87 m long with a 2.7 i.d. The refrigerant flow rate was monitored, along with temperature changes in the fluid and across the tube. Bubble initiation was observed from the free surface extending downward in the tube. Reynolds numbers varied from 6-43 in the liquid phase and 81-204 in the vapor phase. A formulation was made for the low-velocity two-phase flow and good agreement was demonstrated with the simulation. M.S.K.

A82-34076
SYMPOSIUM ON MATERIALS AND NEW PROCESSING TECHNOLOGIES FOR PHOTOVOLTAICS, HOLLYWOOD, FL, OCTOBER 1980, PROCEEDINGS
J. A. AMICK, (ED.) (Exxon Research and Engineering Co., Linden, NJ), E. SIRTL (Heliotronic GmbH, Burghausen, West Germany), P. RAI-CHOUDHURY (Westinghouse Research and Development Center, Pittsburgh, PA), and J. P. DISMUKES (Exxon Research and Engineering Co., Linden, NJ) Symposium sponsored by the Electrochemical Society Pennington, NJ, Electrochemical Society, Inc. (ECS, Proceedings. Volume 81-3), 1981. 355 p $14

The progress towards establishment of commercially viable, mass production solar cells is examined. Photovoltaic programs carried on by U.S., Japan, and European governments are reviewed, along with candidate methods for producing low cost Si cells. Candidate materials and processes include rice hulls, dendritic web formation, silane pyrolysis and deposition in a fixed bed reactor, and purification during crystal pulling. Attention is given to crystalline solar cells, particularly back surface field and interdigitated back contact Si cells, thin film formation techniques and modeling parameters, and materials for modular array construction. Encapsulant investigations are detailed, as are research programs in CdS, Cu2S/CdS, and Be-doped (GaAl)As/GaAs solar cell fabrication. Finally, prototype industrial processes being developed by government-industry cooperation are described. M.S.K.

A82-34077
SOLAR PHOTOVOLTAIC PROGRAMS IN THE SUNSHINE PROJECT AND PRESENT STATUS OF R&D IN JAPAN
Y. HAMAKAWA (Osaka University, Toyonaka, Japan) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 18-36. refs

Solar photovoltaic activities in the national technological development program, the 'Sunshine Project' in Japan are introduced. The philosophy, program milestones, technological development plans and their structures are viewed. Present status of solar photovoltaic R&D projects and some recent remarkable results are described. Current trends in the photovoltaic industry and some application systems scheduled for market stimulation are also demonstrated and discussed. (Author)

A82-34078
CURRENT ASPECTS IN LOW-COST SILICON TECHNOLOGY
J. DIETL (Heliotronic GmbH, Burghausen, West Germany) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 48-59. Bundesministerium fuer Forschung and Technologie refs
(Contract BMFT-NT-0845/0846)

The target of worldwide efforts in manufacturing low-cost Si is to provide an impurity-optimized material suitable for large-scale solar cell fabrication. Different new technologies have been developed but apparently obsolete methods have seen their renaissance likewise. The processes use either quartz, metallurgical-grade silicon or volatile halides as the silicon source material. A survey of high-potential processes is given in terms of abundance of resources and low-cost processing. Low energy consumption, high yield, and high through-put are further criteria of the currently most discussed ways to produce terrestrial solar-grade silicon. (Author)

A82-34079
PURIFICATION OF RICE HULLS AS A SOURCE OF SOLAR GRADE SILICON FOR SOLAR CELLS
J. A. AMICK (Exxon Research and Engineering Co., Linden, NJ) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 60-67. refs

A82-34080* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RELATIVELY LOW-TEMPERATURE PYROLYSIS OF SILANE IN FREE SPACE
H. LEVIN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 68-79. refs

The continuous flow pyrolyzer is a free space reactor that is used to study the effects of concentration, flow rate and temperature in making solar-grade silicon by pyrolysis of silane gas. Work with the continuous flow pyrolyzer is within the DOE-sponsored Low-Cost Solar Array Project. The work has led to a new theoretical treatment of silane pyrolysis in free space at relatively low temperatures (550 C to 750 C). It involves a sequential, three-step mechanism of particle growth: first, silicon atom generation by homogeneous reaction; second, coagulation to a 0.1 micron particle due to Brownian motion and van der Waals forces; and finally, chemical vapor deposition by heterogeneous reaction to final particle size. (Author)

A82-34082
SILICON SHEET - A KEY TO LOW COST SOLAR CELLS
R. H. HOPKINS (Westinghouse Research and Development Center, Pittsburgh, PA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 92-107. refs

The levels of advancement of various methods of mass-producing silicon sheets for solar cells are assessed. Indirect methods involve initial formation of the crystal and then sawing to shape. Growth is produced by either the Czochralski method or by directional freezing. Direct methods involve forming the finished cell in a one-step process, and include capillary shaping, dendritic web, ribbon to ribbon, Si on ceramic, horizontal ribbon growth, roller quenching, and filament guided ribbon growth. The production of commercially producible cells by indirect methods is not regarded as possible. The Si on ceramic process called SCIM is mentioned to avoid impurities buildup by passing graphitized mullite substrates through molten Si up to a rate of 30 cm/min. An efficiency of 10.5% was reported in 1980. Automation is noted to be the production snag, especially for Si web and edge-defined growth methods. The latter has yielded 14.5% efficient cells. M.S.K.

A82-34083
HIGH EFFICIENCY AND RADIATION HARD SOLAR CELLS FROM DENDRITIC WEB SILICON RIBBON
A. ROHATGI, J. R. DAVIS, P. RAI-CHOUDHURY, R. G. SEIDENSTICKER, and R. B. CAMPBELL (Westinghouse Research and Development Center, Pittsburgh, PA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 108-118. refs

Features and performance of dendritic web Si solar cells are examined and compared with float zone Si cells. The web is grown between two dendrites withdrawn from molten Si through a freezing slot. Present web-grown wafers contain three (111) twin planes parallel to the surface. Sample npp cells were produced with boron-doping and a resistance of 1-10 ohm-cm, and float zone cells were grown at 850 C for the front junction and 950 C for the back surface field. Current-voltage characteristics of both kinds of cells were studied at 91.6 mW/sq cm illumination under AM1 conditions. The cells were also examined for radiation resistance by exposure to a 1 MeV electron beam and subsequent observations by spectroscopy. Both cells featured a maximum efficiency of 15%, a figure which was slightly higher after oxide passivation treatment. The web and float zone cells tolerated radiation equally. M.S.K.

A82-34084
METALLURGICAL GRADE SILICON SUBSTRATES FOR SOLAR CELL APPLICATION
F. SECCO DARAGONA, H. M. LIAW, and D. M. HEMINGER (Motorola, Inc., Phoenix, AZ) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 119-131. refs
(Contract XS-9-8119-3)

Sequential steps of purification have been applied to metallurgical grade silicon for the production of low cost Si substrates. The sequential purification includes acid leaching, phase separation, reactive gas treatment, liquid-liquid extraction and impurity redistribution using ingot pulling. The effectiveness of each purification step has been identified. The silicon ingots produced by the sequential purification contain impurity levels at the vicinity of the detection limit of SSMS with the exception of Al, Ti, Ge, P, and B. 7.4% conversion efficiency was obtained for epitaxial solar cells using the purified MG-Si substrates. (Author)

A82-34085
PHOTOVOLTAIC POWER SYSTEMS - STATE OF THE ART - 1980
V. K. KAPUR, J. E. AVERY, and C. F. GAY (ARCO Solar, Inc., Chatsworth, CA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 140-146.

A mass-production process which yields low-cost Si solar cell modules is discussed. Czochralski ingots are grown from semiconductor grade Si and boron is used as the dopant. A resistivity in the range 1-10 ohm-cm in the p-type crystals results and the ingots are sawn to a thickness of 0.015 in. Etching in NaHO eliminates the sawing damage and reduces the reflective losses from 35 to 12%. Phosphorus oxychloride is employed to deposit an n-layer on the wafer. Automated printers deposit silver paste ohmic contacts on the front and aluminum paste on the back surface. Typical I-V curves show a 12.5% efficiency. Polyvinyl butyral sandwiches provide the assembly module of series-connected cells and the entire sheet is imbedded in low-iron glass. Scaling up the process is expected to lower the manufacturing cost to $3-4/kW. M.S.K.

A82-34086* Applied Solar Energy Corp., City of Industry, Calif.
DIAGNOSTIC STUDY OF BSF SILICON SOLAR CELLS
H. YOO, P. ILES, F. HO (Applied Solar Energy Corp., City of Industry, CA), G. POLLOCK, and K. KOLIWAD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 147-158. NASA-supported research. refs

Solar cells equipped with back surface fields (BSF) were fabricated by means of an aluminum alloy, boron diffusion, and boron ion implantation. The importance of initial thickness, resistivity, orientation, and the crystal growth method were examined. Aluminum in paste form was screen printed on the cell, followed by alloy formation at 800 C for a minute. Application of the BSFs resulted in open circuit voltage improvements dependent on the substrate resistivity, ranging from 10 mV at 0.3 ohm-cm to 50 mV at 15 ohm-cm. The gains in performance were attributed to a longer penetration depth, a heightened concentration profile at the interface, and higher concentrations in the p+ layer. M.S.K.

A82-34087
PROCESSING FOR HIGH PHOTOCURRENT IN IBC SOLAR CELLS
F. W. SEXTON, C. M. GARNER, and J. L. RODRIQUEZ (Sandia National Laboratory, Albuquerque, NM) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 159-170. Research supported by the U.S. Department of Energy. refs

The fabrication process and performance characteristics and features of long bulk lifetime, low front and back surface recombination velocities, 10 ohm-cm FZ-grown single crystal Si solar cells are discussed. The cells are interdigitated back contact designs fabricated on 300 microns thick Si wafers, with phosphorus and boron dopants. Quantum efficiency data indicated a minority-carrier lifetime of 350 microsec and a maximum recombination velocity of 30 cm/sec. Laser scans, however, revealed a minimum minority carrier lifetime of 190 microsec. The difference is suggested to be due to front surface recombination reducing the short-circuit current during the laser scans. Back surface passivation is indicated for reducing back surface recombination losses, and a process using 500 A thick wet thermal oxides is recommended. M.S.K.

A82-34088
PARABOLIC MODEL FOR OPTIMIZING GRID AND BUS METALLIZATION PATTERNS IN CIRCULAR SOLAR CELLS
J. A. AMICK and C. FISHMAN (Exxon Research and Engineering Co., Linden, NJ) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 171-186.

A82-34089* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ANALYTICAL CALCULATION OF THICKNESS VERSUS DIAMETER REQUIREMENTS OF SILICON SOLAR CELLS
C. P. CHEN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 187-195. refs

It may be more cost-effective to produce larger diameter silicon Cz solar cells. However, greater thickness is anticipated to be necessary for larger diameter wafers to withstand wafering, cell processing and handling. No material standard for these dimensional requirements is practical or cost-effective for cell manufacturers. The equations relating wafer thickness and diameter were derived by using fracture mechanics analysis. An analytical model was used as a guideline to estimate thickness versus diameter requirements of silicon solar cells in terms of fracture mechanics parameters. (Author)

A82-34090
PRACTICAL LIMITING EFFICIENCIES FOR CRYSTALLINE SILICON SOLAR CELLS
J. A. AMICK and A. K. GHOSH (Exxon Research and Engineering Co., Linden, NJ) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 196-211. refs

A review is given of the factors governing the conversion efficiency for crystalline silicon solar cells at air-mass-1, and of the practical limits on cell efficiencies. Included are losses due to reflection, shadowing, carrier diffusion length, and I-squared(R) dissipation. The influence of polycrystalline grain size on conversion efficiency is also discussed. For conventional cells having a planar junction, a practical limiting efficiency in production appears to be about 17-18% in the absence of sunlight concentration. (Author)

A82-34091
LOW-COST PROCESSES FOR THIN-FILM SOLAR CELLS
R. M. MOORE (Solar Energy Research Institute, Golden, CO) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 212-214. refs

The orientation and goals of a solar cell Exploratory Development program at the Solar Energy Research Institute are described. Thin film photovoltaic manufacturing processes which have shown initial promise for low-cost production of efficient cells will be examined as candidates for entering technology development. Polycrystalline Si was examined initially and succeeding trials will be run with amorphous Si, II-VI, and III-V materials to further define the choice of materials for the process tests. Performance goals are targetted at cells with over 20 sq cm area exceeding an 11% AM1 efficiency and thin film modules with an AM1 output of 8 W. M.S.K.

A82-34092* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ION IMPLANTATION OF SOLAR CELL JUNCTIONS WITHOUT MASS ANALYSIS
D. FITZGERALD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and D. G. TONN (California Institute of Technology, Pasadena, CA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 215-222. Research sponsored by the U.S. Department of Energy and NASA.

This paper is a summary of an investigation to determine the feasibility of producing solar cells by means of ion implantation without the use of mass analysis. Ion implants were performed using molecular and atomic phosphorus produced by the vaporization of solid red phosphorus and ionized in an electron bombardment source. Solar cell junctions were ion implanted by mass analysis of individual molecular species and by direct unanalyzed implants from the ion source. The implant dose ranged from 10 to the 14th to 10 to the 16th atoms/sq cm and the energy per implanted atom ranged from 5 KeV to 40 KeV in this study. (Author)

A82-34093* Springborn Labs., Inc., Enfield, Conn.
PHOTOVOLTAIC ENCAPSULATION MATERIALS
B. BAUM, P. W. WILLIS (Springborn Laboratories, Inc., Enfield, CT), and E. C. CUDDIHY (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 223-260.

Candidate materials for the construction of cost-effective solar cell flat array modules are reviewed. Fabrication goals include electricity production at $.70/W with a lifetime of 20 yr. Research is currently directed toward low cost encapsulants and substrates for the cells, and outer covers which resist weathering. Ethylene/vinyl acetate copolymer (EVA) at $.09/sq ft has displayed the most promising results as the encapsulant laminate when subjected to peroxide cross-linking to prevent melting. EVA accepts the addition of antioxidants, quenchers, absorbers, and stabilizers. Wood is favored as the rigid substrate due to cost, while top covers in substrate modules comprise candidate acrylic and polyvinyl fluoride films and a copolymer. Finally, fiberglass mat is placed between the substrate and the EVA pottant as a mechanical support and for electrical insulation. M.S.K.

A82-34095
TERRESTRIAL SOLAR MODULES
W. SAMPSON and S. OLAH (Applied Solar Energy Corp., City of Industry, CA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 266-270.

Processing methods and materials for the fabrication of solar cell modules are reviewed. It is noted that current production favors copper, particularly in mesh form, as the cell interconnect material due to suitability for stress relief configurations to offset the effects of thermal expansion and deficiencies in the bond between copper and Si. Ethylene vinyl/acetate is preferred to polyvinyl butyral as an encapsulant because it is also a dry film and adheres at low temperature without requiring a pressure bond. The thermal cycling parameters have been set at -40 to 90 C, and tempered low iron, high transmission, water white glass is used as the superstrate. A conceptual design for an automated production of the encapsulated cells is outlined, including the ability to make front and back interconnects and achieve accurate soldering due to the precise location of the solar cells in the process. M.S.K.

A82-34096
THE ROLE OF BE IN /GAAL/AS/GAAS SOLAR CELLS
K. MASU, S. NAKATSUKA, M. KONAGAI, and K. TAKAHASHI (Tokyo Institute of Technology, Tokyo, Japan) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 295-303. refs

The fundamental effects of Be diffused into (GaAl)As/GaAs solar cells and also the electrical properties of Be doped layers were examined. The diffusion coefficient in a p-type cell was found to vary with temperature and concentration during formation at 700-900 C in a liquid phase epitaxial process. The thickness of the Be-doped region was also found to vary with the growth temperature, in proportion to the square root of the diffusion time. The van der Pauw method was employed to examine the electrical properties by determining the average resistivity, hole mobility, and free-carrier concentration. The resistivity matched previous results for Zn-doped layers while the acceptor energy level was 47 meV, implying the suitability of the use of Be as a means to reduce the sheet resistance of (GaAl)As/GaAs cells. An electron diffusion length of 4.2 microns was observed for a free-carrier concentration of 10 to the 18th/cu cm. M.S.K.

A82-34097
THE CLEFT PROCESS - A TECHNIQUE FOR PRODUCING EPITAXIAL FILMS ON REUSABLE SUBSTRATES
J. C. C. FAN, C. O. BOZLER, and R. W. MCCLELLAND (MIT, Lexington, MA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 304-311. USAF-supported research. refs

The peeled-film technique called CLEFT is discussed as a means to achieve cost reductions in semiconductor materials for GaAs solar cells. Using vapor-phase epitaxial growth permits cleavage of the epitaxial film from a substrate by first placing a suitable mask, e.g., carbonized photoresist, on the substrate. Photolithographic processes etch strip openings in the carbonized layer. After solidification the epitaxial layer can be cleaved off the weak, carbonized mask. A GaAs single crystal substrate has been used repeatedly and electrical measurements have shown no performance degradation in the deposited film. GaAs films with a thickness of 8 microns formed by the technique have displayed AM1 efficiencies of 15%. Possible fabrication of films 0.1 micron thick are indicated. M.S.K.

A82-34099* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TECHNOLOGY TRANSFER - LSA PROJECT TO INDUSTRY
B. D. GALLAGHER (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In: Symposium on Materials and New Processing Technologies for Photovoltaics, Hollywood, FL, October 1980, Proceedings. Pennington, NJ, Electrochemical Society, Inc., 1981, p. 320-325. Research sponsored by the U.S. Department of Energy and NASA.

Program goals, procedural steps, and examples of different situations encountered in the Low-cost Solar Array (LSA) project managed at the Jet Propulsion Laboratory in conjunction with industrial contractors are outlined. The project is intended to result in the production-ready status of photovoltaic panels which produce power at $.70/peak W by 1986. The first phase of the program identified materials and processes which were promising for further development. Phase II served to correct steps and materials which did not work and were important to the array processing. The third phase will bring the processes to technical readiness by demonstration of successful fabrication of modules at a scale which can be increased to commercial production. An information exchange is ongoing between manufacturers and the JPL to alter specific steps which yield results which vary from those found in the laboratory when transferred to the factory. M.S.K.

A82-34489
PROPERTIES OF SPRAY-DEPOSITED COBALT OXIDE SELECTIVE COATINGS ON ALUMINIUM AND GALVANISED IRON SUBSTRATES
C. CHOUDHURY and H. K. SEHGAL (Indian Institute of Technology, New Delhi, India) Applied Energy, vol. 10, Apr. 1982, p. 313-324. refs

A low cost, single step process using spray pyrolysis for the growth of highly adherent and stable cobalt oxide films on commercially available aluminum and galvanized iron to form a flat plate collector selective surface is described. Acetone-degreased substrates were heated into the 150-230 C range and sprayed with Co(NO3)2,6H2O to deposit the films. Photothermal, electron diffraction, scanning electron microscope, spectrophotometric, and thermal emittance tests were performed on prepared samples. Adhesion was examined by 50 tape-pulling tests for each surface, then twenty more after thermal cycling to 600 and 400 C with aluminum and galvanized iron substrates, respectively. Both coatings were found superior to black paint. The best performance was with substrates kept at 180 C during deposition, with film layers of 0.30 micron on aluminum and 0.32 micron on galvanized iron. M.S.K.

A82-34540
PREPARATION AND ANALYSIS OF CDS-CU2S SOLAR CELLS
L. MAHDJOUBI, M. DERDOURI, and M. BENMALEK (Organisme National de la Recherche Scientifique, Centre des Sciences et de la Technologie Nucleaires, Algiers, Algeria) (Thin Film Solar Cells Meeting, Newcastle-upon-Tyne Polytechnic, Newcastle-upon-Tyne, England, Apr. 1981.) Solar Cells, vol. 5, Mar. 1982, p. 205-212. refs

The fabrication steps and performance characteristics of CdS-layers for CdS-Cu2S solar cells are detailed. CdS was evaporated on a graphite source at source and substrate temperatures of 1050 and 200 C, respectively. An Au-CdS Schottky diode was also formed by thermally depositing a 1000 A thick layer of gold onto the CdS layer. Samples were prepared with the Au coating directly from vacuum, after etching in HCl, and by performing the whole process in a vacuum. The cells were then dipped in a CuCl solution at 90 C for 5 sec to form a p-type Cu2S layer. The CdS cell layer has an absorption spectrum in the range 2.36-2.44 eV with a c-axis in perpendicular orientation to the substrate. An additional heat treatment of 200 C for 3 min was found to enhance the cell efficiency by changing the Cu(x)S phases to Cu2S at the interface. Further work is indicated on the growth of the Cu2S growth step. M.S.M.

A82-34541
PHOTOVOLTAIC PERFORMANCES OF CU2S/CDS SPRAYED SOLAR CELLS
M. SAVELLI, J. BOUGNOT, H. LUQUET, M. PEROTIN, O. MARIS, and C. GRIL (Montpellier II, Universite, Montpellier, France) (Thin Film Solar Cells Meeting, Newcastle-upon-Tyne Polytechnic, Newcastle-upon-Tyne, England, Apr. 1981.) Solar Cells, vol. 5, Mar. 1982, p. 213-229. refs

The fabrication and results of optimization tests on sandwich Cu2S/CdS solar cells with an indium-tin-oxide (ITO) layer are reported. The cells were formed in a chemical spray deposition process, producing suceeding layers of Cu, Cu2S, CdS, CdS doped Al, ITO, and pyrex. The ITO displayed a constant transmission efficiency as a transparent electrode, with transparency being optimized around 90 percent with a sheet resistance of 7 ohms. The ITO layer thickness was optimized by examining the current-voltage curves, leading to a 0.4 micron edge causing a minimized 8 percent loss to the cell efficiency. The best growth rate of the CdS film was determined to be 2 microns/h with a substrate temperature of 400 C. The cell displayed a maximum efficiency of 7.4 percent and a maximum response with a 0.55 micron thick front layer. Further work to optimize the CdS transparency, reduce the interface states, and improve the performance after encapsulation is indicated. M.S.K.

A82-34542
SINGLE-CRYSTAL ZN/X/CD/1-X/S/CU2S PHOTOVOLTAIC CELLS
S. OKTIK, G. J. RUSSELL, and J. WOODS (Durham, University, Durham, England) (Thin Film Solar Cells Meeting, Newcastle-upon-Tyne Polytechnic, Newcastle-upon-Tyne, England, Apr. 1981.) Solar Cells, vol. 5, Mar. 1982, p. 231-241. refs

Results of an investigation of the performance characteristics of ZnCdS/Cu2S solar cells are reported. Single crystal cells were grown with a Zn contribution between 0-0.4 and resistivities ranging from 0.5-2.0 ohm-cm. An In ohmic contact was placed on the Cd base plane and the CuS layer was formed on the sulfur layer by means of the wet-plating method. I-V characterization under 100 mW/sq cm illumination revealed that the open-circuit voltage increased with the Zn content while the short-circuit current and the fill factor decreased. Cell baking in air at 200 C had a less beneficial effect with the increasing Zn content. Spectral response examinations revealed that the major response occurred at peaks of 0.7 and 0.96 microns regardless of the composition of the substrate, and electron diffraction studies linked the responses to the formation of chalcocite and djurleite. Finally, it is noted that baking at 200 C for 4 min shifted the response peaks toward lower wavelengths. M.S.K.

A82-34543
TRENDS AND PROBLEMS IN CDS/CU/X/S THIN FILM SOLAR CELLS - A REVIEW
S. MARTINUZZI (Aix-Marseille III, Universite, Marseille, France) (Thin Film Solar Cells Meeting, Newcastle-upon-Tyne Polytechnic, Newcastle-upon-Tyne, England, Apr. 1981.) Solar Cells, vol. 5, Mar. 1982, p. 243-268. refs

The methods currently used to fabricate CdS/CuS solar cells are reviewed, along with comparisons of the effects on performance of the various preparation techniques. Attention is given to thermal evaporation, sputter, and chemical spray formation of the CdS layers, noting that most experience is presently with the evaporative and spray processes. CuS layers are formed in dip or wet process chemiplating, electroplating, vacuum deposition in flash and sputter modes, solid state reaction, or spray deposition. Any of the CuS film techniques can be used with any of the CdS layer processes, while spraying and sputtering are noted to offer the best alternatives for industrial production. Band profiles, I-V characteristics, photocurrent levels, and capacitance-voltage characteristics are outlined for the differently formed cells, and CdS/CuS and CdZnS/CuS cells are concluded to exhibit the highest performance features. Areas of improvement necessary to bring the cells to commercial status are discussed. M.S.K.

A82-34544
SIMULATION OF THE BEHAVIOUR OF A SET OF CU2S-CDS UNIT PHOTOCELLS
J. L. JACQUEMIN and G. BORDURE (Montpellier II, Universite, Montpellier, France) Solar Cells, vol. 5, Mar. 1982, p. 269-274.

A computer model was employed to simulate the performance of a panel of 30 solar cells in order to determine the contribution expected from the individual cells. The cells array was modeled on the bases of series and parallel resistance, saturation current density, short-circuit current, and the number of cells. I-V curves were calculated for the mean performance of a batch of thirty cells and the performance of the best cell produced in the batch. Substituting low efficiency cells in a normal parallel array was found to potentially seriously degrade the performance of the whole array. The most important parameters determining the array performance were determined to be the efficiency, open-circuit voltage, short-circuit current, and the saturation current, while the number of cells, resistances, and the fill factors did not significantly impinge on the array output. M.S.K.

A82-34545
INEFFECTIVENESS OF LOW-HIGH JUNCTIONS IN OPTIMIZED SOLAR CELL DESIGNS
H. T. WEAVER (Sandia National Laboratory, Albuquerque, NM) Solar Cells, vol. 5, Mar. 1982, p. 275-292. Research supported by the U.S. Department of Energy. refs

An attempt to prove that conventional Si solar cells (CV) are as promising as the developmental goals for back-surface field (BSF) and low substrate resistivity high-low emitter (HLE) cells is presented. The work is focused on 300 microns thick pnn and ppn cells, the generic type of CV cells currently available. Governing differential equations are presented to model cell performance in terms of numerical solutions to the transport equations. It is noted that the only difference between CV cells and BSF cells is that CV cells do not have rear surface diffusion. Configuring the cells to take full advantages of the BSF feature results in a cell with much the same efficiency of a CV cell, except under either concentration modes or with 50 microns thick thin cells. Finally, an HLE cell with a 10-25 microns thick layer doped to 10 to the 16th/cu cm can offer only a minor efficiency increase over the best available CV cells. M.S.K.

A82-34546
THE EFFECTS OF NON-UNIFORM ILLUMINATION OF SOLAR CELLS WITH CONCENTRATED LIGHT
H. PFEIFFER and M. BIHLER (Maschinenfabrik Augsburg-Nuernberg AG, Munich, West Germany) Solar Cells, vol. 5, Mar. 1982, p. 293-299. Research supported by the Commission of the European Communities and Bundesministerium fuer Forschung und Technologie. refs

Experimental results for trials to determine the effects of nonuniform illumination and varying the intensity of illumination on solar cells connected in series in a concentrator configuration are presented. A simulator with 9000 W/sq m was used to test 5 x 5 cm Si cells in factor of 10 concentrator configurations. Cells were subjected to uniform lighting with filters to control and outer 1 cm edge illumination and in another trial where whole cells were deprived of light by a filter. The filters were calibrated to have transmission factors of 89, 56, 44, and 21%. Losses due to uneven illumination were a maximum of 3%, even with a 50% variance in concentration. Totally blocking light to a cell in a series stopped the whole generator's output, while a 10% difference in light to two cells resulted in only a 2% power loss. Neither site nor geometry exhibited any effect on the output. It is concluded that shape standards for concentrators can be relaxed. M.S.K.

A82-34551
THEMIS - A SOLAR POWER STATION [THEMIS - LA CENTRALE SOLAIRE]
J. HILLAIRET (Electricite de France, Marseille, France) Entropie, vol. 18, no. 103, 1982, p. 6-10. In French.

The organization, goals, equipment, costs, and performance of the French Themis (Thermo-helio-electric-MW) project are outlined.

The program was begun for both the domestic energy market and for export. The installation comprises a molten eutectic salt loop which receives heat from radiators situated in a central tower. The salt transfers the heat to water for steam generation of electricity. A storage tank holds enough molten salt to supply one day's reserve of power, 40 MWh. A field of heliostats directs the suns rays for an estimated 2400 hr/yr onto the central receiver aperture, while 11 additional parabolic concentrators provide sufficient heat to keep the salt reservoir at temperatures exceeding 200 C. In a test run of several months during the spring of 1982 the heliostats directed the sun's rays with an average efficiency of 75 percent, yielding 2.3 MW of power at a system efficiency of 20.5 percent in completely automatic operation. M.S.K.

A82-34552
THE THEMIS HELIOSTAT FIELD [LE CHAMP D'HELIOSTATS DE THEMIS]
A. COLLON (Electricite de France, Marseille, France) and A. LECLERC (CETHEL, Neuilly-sur-Seine, Hauts-de-Seine, France) Entropie, vol. 18, no. 103, 1982, p. 10-20. In French.

The 201-heliostat field which supplies solar rays to the central receiver as part of the Themis project is detailed. Each heliostat has 54 sq m of surface and is connected with all others in a central control circuit. The energy is directed to a square aperture 4 m on a side. The control logic is written in three levels, with microprocessors located in each heliostat drive to follow commands of a central computer. The reflector field is subsequently divided into zones in order to maximize control efficiency and power deposition on the receiver as the day progresses. A maximum of 9.7 MWth is shone on the power tower at an operational efficiency of 77 percent. A cylindrical shape was chosen for the array, which turns face downward to survive in strong winds. Emergency procedures which would also cause the plant to shut down due to an accident in the primary loop are explored, along with hazards to human eyesight from seeing the reflected flux. M.S.K.

A82-34553
THE THEMIS SOLAR RECEIVER [LE RECEPTEUR SOLAIRE THEMIS]
J. M. GRAVRAND (Constructions Navales et Industrielles de la Mediterrannee, La Seyne-sur-Mer, Var, France) and X. POUGET-ABADIE (Electricite de France, Marseille, France) Entropie, vol. 18, no. 103, 1982, p. 20-29. In French. refs

The theoretical modeling, materials, and design of the central receiver heat exchanger on the tower of the Themis solar power plant are presented. The receiver was conceived based on the incident solar flux at different times of the day and year and the efficiency of transferring the heat to molten salts. The square aperture admits energy at a peak rate of 3.402 MWth at some points, with heat transfer to the power loop resulting in a maximum efficiency of 25 percent. Optimization studies indicated a receiver inclined 30 deg from the horizontal to face the heliostat field, and the flux incident on the walls was mapped. Tubes filled with the salts at 250 C form the walls behind radiator fins and elevate the salt to temperatures up to a limit of 490 C. Measures taken to allow for the expansion of the cavity walls and to mount the heat exchange tubes for easy replacement are described, along with the instrumentation to measure performance, flux, and detect malfunctions due to perturbations in the fluid flow or failure of any of the components. M.S.K.

A82-34554
THE THERMODYNAMIC CONVERSION OF SOLAR ENERGY - TECHNICAL AND ECONOMIC COMPARISON OF DIFFERENT POWER PLANTS [CONVERSION THERMODYNAMIQUE DE L'ENERGIE SOLAIRE - COMPARAISON TECHNIQUE ET ECONOMIQUE DE DIFFERENTES FILIERES]
C. ETIEVANT (CNRS, GESER, Chatenay-Malabry, Hauts-de-Seine, France) and M. ROCHE (Electricite de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) Entropie, vol. 18, no. 103, 1982, p. 30-47. In French. refs

An examination of the costs, materials, and construction of various solar-thermal power plants is made, starting from data derived from fabrication and operation of the Themis power plant. The cycles considered include steam generation, eutectic or draw salts, molten sodium and air, and air, powered by flux from a central receiver or by multiple parabolic concentrators. All designs involve a scaling up of the 1 MW Themis plant to at least 10 MWe, and gas generator systems, using, e.g., helium, are regarded as feasible only with a few tens of MWe output. The systems are discussed in terms of the components and performance of the primary circuit, heat storage, and the efficiency of the thermodynamic cycle. Optimizing the heliostats is shown to be necessary in order to reduce costs and required units. It is concluded that higher temperatures are necessary for economical application, and that heat storage must be included. M.S.K.

A82-34555
POWER PLANT I - FUSED SALT [FILIERE I - SEL FONDU]
M. ROCHE (Electricite de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) Entropie, vol. 18, no. 103, 1982, p. 48-52. In French.

A solar thermal power plant using fused salt as the heat transfer fluid for steam power generation is analyzed for the feasibility of economic operation. The salt is also stored in a tank reservoir for maintaining the primary heat loop at temperatures high enough for the salts to remain liquid, and also to provide reserve power for the steam generator. Initial studies were with eutectic (hitec) salt comprising Na, KOH, and nitrites melting at 146 C, and further studies were performed employing draw salt, which has no nitrite, is more stable at high temperature, and melts at 225 C. The use of draw salt was found to allow a 5 percent reduction in storage capacity. Further examinations of the effects of the hitec salts on corrosion and composition degradation at high temperatures are indicated. The molten salt system is projected to offer an efficiency of 26 percent. M.S.K.

A82-34556
POWER PLANT II - SODIUM-WATER [FILIERE II - SODIUM-EAU]
M. ROCHE (Electricite de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) Entropie, vol. 18, no. 103, 1982, p. 53-57. In French.

The implementation of a sodium based heat exchange loop is presented as a means of reducing the required size of a solar thermal power plant heat exchanger. Sodium as a heat transfer fluid allows operations near 535 C with electromagnetic pumps. It is noted that sodium must be completely sealed in and surrounded with a neutral gas such as nitrogen or argon. The higher temperatures pave the way for a more efficient thermodynamic cycle, although the Themis receiver would necessarily need a faster loop in addition to more absorbent surfaces to adequately handle the sodium liquid. The steam lines would be helically wound in a chamber through which the sodium flows linearly downward. Storage is concluded to not be feasible under current technology due to the violent reactions possible between sodium and water or hitec salts. An auxiliary heat source would be required. M.S.K.

A82-34557
POWER PLANT III - STEAM [FILIERE III - EAU-VAPEUR]
M. ROCHE (Electricite de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) Entropie, vol. 18, no. 103, 1982, p. 58-62. In French.

The projected principal components, performance, and costs associated with a direct cycle steam generating solar thermal power plant producing over 10 MWe are examined. Calculations are given for a location in south France, using heliostat and heat exchanger technology developed for Themis. The heat exchanger would have vertical tubes on the side walls for natural circulation, with superheater channels at the top composed of austenitic steels. Temperature of the superheated steam could be regulated by injections of liquid water. Maintaining the pressure during the passage of clouds is taken to require the presence of an auxiliary boiler burning fossil fuels, since no method is presently known of storing latent heat at over 300 C. Approaching clouds would have

to be detected in order to stop the heliostats and ignite the back-up systems. M.S.K.

A82-34558
POWER PLANT IV - THEM-THEK [FILIERE IV - THEM-THEK]
M. PONS (CNRS, GESER, Chatenay-Malabry, Hauts-de-Seine, France) Entropie, vol. 18, no. 103, 1982, p. 63-70. In French.

A 10 MWe solar thermal hybrid central receiver-parabolic concentrator power plant is described. The THEK field of parabolic concentrators is employed to preheat and vaporize the water for heating the primary loop, while the THEM central receiver receives solar flux input from a field of heliostats to superheat fused salt, hitec, for the steam-powered generation of electricity. The preheat system also serves to maintain latent heat in the fused salt reservoir. An extra bypass with separation allows the vaporized portion of salt to return to the superheater as condensed salt descends to the reservoir to gain heat, thereby increasing the system efficiency by 8 percent to 33.8 percent. The power unit is coupled to turbines spinning at 9000 rpm. The central aperture closes during cloudy conditions to avoid heat losses in the primary loop. M.S.K.

A82-34559
POWER PLANT V - THEK GENERATING STATION [FILIERE V - CENTRALE THEK]
M. PONS (CNRS, GESER, Chatenay-Malabry, Hauts-de-Seine, France) Entropie, vol. 18, no. 103, 1982, p. 71-75. In French.

The design and operating features of a 10 MWe parabolic dish concentrator steam-cycle generating plant are described. The dishes which have 75 sq m area with a concentration factor of 265, were proved in the Themis project. The total field for the 10 MWe would cover 63,100 sq m and require 842 units. Using a water-steam cycle at 50 bars, temperature would never surpass 264 C, with an after-generator condition of 33 bars at 204 C. Preheating the water is intended with a fused salt reservoir containing 570 tons in 350 cu m container, around which condensed water would flow. Maintaining the primary loop at mildly elevated temperatures would permit uninterrupted operation during cloudy periods. A total shutdown would occur if cloudy conditions last more than one hour, and start-up would involve reheating the primary loop, recharging the storage, and then respinning the turbine. M.S.K.

A82-34560
POWER PLANT VI - SODIUM-AIR [FILIERE VI - SODIUM-AIR]
R. GENIER (Electricite de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) Entropie, vol. 18, no. 103, 1982, p. 76-80. In French.

A sodium-air cycle central receiver solar electric generating plant is described. The system is designed for liquid sodium to be heated to 750 C in the central receiver heat exchangers, pumped down to the tower base to transfer heat to an air loop, then be returned to the receiver aperture. The air loop would heat to 730 C, insufficient for efficient operation of turbines, and would require a further heating by a supplementary burner to temperatures of 950 C. An efficiency of 35.4 percent is projected for a total output of 10,620 kW. The flux is furnished by a field of 743 heliostats with a total surface area of 36,425 sq m, and received by a tower 120 m tall outfitted with a receiver inclined 45 deg from the horizontal. The sodium-air heat exchange is envisioned to take place in a tank of air interpenetrated by continuous, closed, boustrophedonic loops filled with superheated sodium. M.S.K.

A82-34561
POWER PLANT VI REVISITED - SODIUM-AIR /A GRID-BOILER/ [FILIERE VI BIS - SODIUM-AIR /CHAUDIERE A GRILLE/]
M. ROCHE (Electricite de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) Entropie, vol. 18, no. 103, 1982, p. 81-85. In French.

A configuration which allows operation of a sodium-air dual-loop central receiver at elevated cycle temperatures is presented. The heliostat field covers an area of 43,000 sq m for directing a flux of 23,260 kWth to the power tower aperture. The front of the receiver contains part of a closed sodium loop, which is also directed into a heat exchanger chamber where energy is transferred to a rising column of air used to turn the generators. The air enters the chamber at 292 C, is heated to 700 C, flows on to the back of the receiver enclosure where the temperature is raised to 850 C, and then on to a turbine generator. Supplemental fossil fueled heat may be necessary to maintain the higher temperatures in unfavorable conditions. A plant with a total output of 7720 kW operating at 33.75 percent efficiency is considered feasible. M.S.K.

A82-34562
POWER PLANT VII - AIR-AIR /TUBE BOILER/ [FILIERE VII - AIR-AIR /CHAUDIERE A TUBES/]
M. ROCHE (Electricite de France, Direction des Etudes et Recherches, Chatou, Yvelines, France) Entropie, vol. 18, no. 103, 1982, p. 86-90. In French.

An attempt to design a solar thermal electric central receiver power plant in the multi-MW size with acceptable efficiencies using air in the power loop is described. The turbine and generator are placed in the tower to reduce heat losses in the superheated gas, and the depleted gas loop is coupled to a low temperature generator powered by boiling water. The receiver cavity is configured to retain a maximum amount of flux and has brick walls. Nickel alloys are indicated for the air tubes in the receiver, with Inconel 601, Incoloy 800, and Inconel 600 considered acceptable. The gas leaving the chamber will be at 950 C to power a high pressure turbine, followed by entrance into a heat exchanger to boil the water for the low-pressure turbine, and is then discharged. Thermodynamic efficiencies between 13.9-20.3 percent for a 4700 kW plant are considered feasible with the design. M.S.K.

A82-34563
POWER PLANT VII REVISITED - AIR-AIR /SCIROCCO/ [FILIERE VII BIS AIR-AIR /SIROCCO/]
C. ETIEVANT (CNRS, GESER, Chateney-Malabry, Hauts-de-Seine, France) and D. ROYER (Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay Gif-sur-Yvette, Essonne, France) Entropie, vol. 18, no. 103, 1982, p. 91-97. In French.

A hybrid fossil fuel-solar central receiver power plant is described, noting principally a 'Scirocco' configuration for the receiver. The primary loop contains air which enters passages in the alveolar-configured walls of the boiler, which is semi-spherically shaped. The alveoles are located in the back of the cavity while the upper and lower surfaces are reflective. A heat flux of 24.4 MWth is delivered to the aperture by 668 heliostats, each having a 53 sq m surface. Air is heated to 660 C and then flows past flame tubes to attain temperatures near 900 C through use of a combustor before impinging on the turbine blades. It is noted that although only 1000 hr of functioning are currently available for the Scirocco configuration, it offers the chance to reduce the size of the boiler. Further studies to optimize the materials for the boiler are indicated. M.S.K.

A82-34564
ANNUAL PRODUCTIVITY OF A SOLAR THERMOELECTRIC POWER PLANT [BILAN ANNUEL DE CENTRALES HELIOTHERMOELECTRIQUES A CONCENTRATION]
B. RIVOIRE (CNRS, GESER, Chatenay-Malabry, Hauts-de-Seine, France) Entropie, vol. 18, no. 103, 1982, p. 98-103. In French.

A82-34565
STATE OF THE ART IN SOLAR THERMOELECTRIC POWER PLANT RESEARCH [ETAT DES RECHERCHES SUR LES CENTRALES SOLAIRES DE PUISSANCE DANS LE MONDE]
C. ETIEVANT (CNRS, GESER, Chatenay-Malabry, Hauts-de-Seine, France) Entropie, vol. 18, no. 103, 1982, p. 104-115. In French. refs

World wide research efforts to develop multi-MW solar central receiver thermoelectric power plants are outlined, noting that only this form of solar energy, coupled with storage, permits adjusting output to meet loads. Among the systems described, which are

all heliostat-tower configurations, are the 500 MWe SSPS-CRS of the IEA located in southern Spain, the Eurelios station producing 1 MWe on Sicily, and the 1 MWe CESA-1 plant at Tabernas, Spain. Descriptions are also given of the 1 MWe installation at Nio, Japan, the Themis project in France with an output of 2000-2500 MWe, the Soviet CES-5 5 MWe power plant in Lenino on the shore of the Sea of Azov, and the 10 MWe Solar-1 project in Barstow, CA. The systems employ hot air, steam, sodium, or fused salt as heat exchanger fluids, and are being tested for use in producing grid-quality electricity, industrial heat, combustible liquids, and to repower fossil-fuel fed generator cycles. M.S.K.

A82-35246
RF SPUTTERED GOLD-AMORPHOUS SILICON SCHOTTKY-BARRIER DIODES
L. XU, D. K. REINHARD (Michigan State University, East Lansing, MI), and M. G. THOMPSON (Michigan Technological University, Houghton, MI) IEEE Transactions on Electron Devices, vol. ED-29, June 1982, p. 1004-1006. refs
(Contract NSF ENG-79-10896)

Gold Schottky-barrier diodes formed on reactively sputtered amorphous silicon thin films have been investigated. Device forward I-V characteristics are well modeled as a Schottky diode in series with a temperature activiated series resistor. At 300 K, the forward current indicates a diode correction factor of 1.4 and a saturation current of 5.8 x 10 to the -10th A/sq cm. The metal-semiconductor barrier height is 0.93 eV. Capacitance versus frecuency measurements indicate a depletion region thickness of 3000 A. In the depletion region, the mobility-lifetime products are estimated to be of the order of 5 x 10 to the -11th sq cm/V which is substantially less than the value of 10 to the -7th sq cm/V in the quasi-neutral region. It is suggested that deep gap states are responsible for this difference. Carrier recombination in the depletion region limits the photovoltaic performance. (Author)

A82-35247
NEW EXPERIMENTAL EVIDENCE FOR MINORITY-CARRIER REFLECTION AT NEGATIVE-BARRIER MIS CONTACTS
N. G. TARR, D. L. PULFREY (British Columbia, University, Vancouver, Canada), P. A. ILES (Applied Solar Energy Corp., City of Industry, CA), and A. NEUGROSCHEL (Florida, University, Gainesville, FL) IEEE Transactions on Electron Devices, vol. ED-29, June 1982, p. 1016-1021. refs

Recently, measurements of the open-circuit voltage of solar cells with negative-barrier metal-insulator-semiconductor (MIS) back contacts have been used to demonstrate that such contacts can function as the electrical analogues of metallurgical high-low junctions. In this brief, further experimental evidence for the minority-carrier reflecting properties of the negative-barrier MIS junction is presented. First, it is shown that a negative-barrier Mg-SiO(x)nSi back contact can be used to enhance the long-wavelength photoresponse of p(+)n solar cells in the same manner as a diffused n(+) back-surface field. Secondly, measurements of the effective surface-recombination velocity for an Mg-SiO(x)-nSi contact and for a diffused n-n(+) high-low junction formed on an identical substrate are reported. Both junctions gave very low values of recombination velocity, on the order of 50 cm/sec. (Author)

A82-35496
GRAIN BOUNDARY RECOMBINATION ANALYSIS OF GAAS SCHOTTKY BARRIER SOLAR CELLS
R. J. SOUKUP and G. P. BARTUNEK (Nebraska, University, Lincoln, NE) Journal of Applied Physics, vol. 53, June 1982, p. 4428-4434. refs

A cylindrical grain is used to model the short circuit current density of a thin film polycrystalline GaAs Schottky barrier solar cell. Both backwall and frontwall solar cells are considered and it is found that the optimum thickness for either cell is less than 2.5 microns if reflection of solar energy from the back metallic contact is considered. The grain size and grain boundary recombination velocity affects each cell in the same way. However, the ohmic contact recombination velocity has a greater influence on the backwall solar cell. The conclusion of this study is that although the backwall cell is potentially more efficient, the frontwall cell is less influenced by semiconductor and contact parameter variation and thus, for production quantities, the frontwall cell will yield more consistent results. (Author)

A82-35500
MODIFICATION OF OPEN-CIRCUIT VOLTAGE OF METAL-INSULATOR-SEMICONDUCTOR SOLAR CELLS DUE TO A NONUNIFORM INSULATING LAYER
H. L. CHAU and Y. C. CHENG (University of Hong Kong, Hong Kong) Journal of Applied Physics, vol. 53 June 1982, p. 4544, 4545.

The effect of nonuniformity of the insulating layer on metal-insulator-semiconductor, open-circuit voltage is examined. It is based on a simplified model in which insulator limits the dark current via different effects. The enhancement in open-circuit voltage could be greatly degraded by surface roughness. (Author)

A82-35501
BASIC RESEARCH NEEDS AND OPPORTUNITIES ON INTERFACES IN SOLAR MATERIALS; PROCEEDINGS OF THE WORKSHOP, DENVER, CO, JUNE 30-JULY 3, 1980
A. W. CZANDERNA, (ED.) (Solar Energy Research Institute, Golden, CO) and R. J. GOTTSCHALL (U.S. Department of Energy, Office of Basic Energy Sciences, Washington, DC) Workshop sponsored by the U.S. Department of Energy. Materials Science and Engineering, vol. 53, Apr. 1982, 178 p.

Research areas, instrumentation, and existing theoretical models for solid-solid, solid-liquid, and solid-gas interfaces which exist as part of solar energy conversion devices (SECS) are examined. The devices require a thirty-year operative lifetime in order to acquire economic viability. Degradation processes can occur during manufacturing and/or operation of SECS, and performance improvements are available only through increasing mechanical, chemical, atomic, and electronic characterization of microscopic properties and topologies of converters. Attention is given to instrumentation which extends the ability to model the atomic behaviors of interfacial layers of solar devices such as heliostats, solar cells, wind turbine blades, absorbers, and concentrator mirrors, including Auger electron microscopy, reflection absorption IR, electron energy loss spectroscopy, etc. Specific attention is given to vapor-deposition manufacturing processes. M.S.K.

A82-35502
OVERVIEW OF SOLAR ENERGY CONVERSION TECHNOLOGIES - QUANTUM PROCESSES AND THERMAL PROCESSES
P. J. CALL (Solar Energy Research Institute, Golden, CO) (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 7-16. refs

A82-35503
DESIGN REQUIREMENTS FOR INTERFACES IN SOLAR ENERGY CONVERSION TECHNOLOGIES
B. L. BUTLER (Solar Energy Research Institute, Golden, CO) (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 17-24. refs

Candidate materials for improving the durability and economics of solar energy conversion systems (SECS) are reviewed. A 30-yr lifetime is regarded as necessary for solar collector and concentrator materials in order to offset the high initial costs of SECS in parabolic dish, heliostat, parabolic trough, flat plate collector, OTEC, solar cell, and wind turbine configurations. The materials are required to transfer a maximum amount of intercepted energy without degrading from exposure to UV radiation, wind, water, dust, and temperature cycling. Glass and mirrored surfaces

for reflecting or refracting optical subsystems are currently made from soda-lime, boro- and aluminosilicate, and must resist chemicals, abrasion, and permeability, and have good strength, flexibility, coefficient of expansion, and Young's modulus. Additional concerns are present in photochemical, solar cell, and in substrata components and systems. M.S.K.

A82-35505
OVERVIEW OF THE CURRENT STATUS OF SOLID-LIQUID INTERFACE SCIENCE
J. O'M. BOCKRIS (Texas A & M University, College Station, TX) (U.S. Department of Energy, Workshop on Basic Research Needs and Opporutnities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 47-64. refs

The effectiveness of present techniques for examining the solid-liquid (S-L) interface in photoelectrochemical devices is reviewed. The S-L interface is presently modeled using the Guoy layer theory, although statistical deficiencies are present due to the large number of species to be modeled. The development of ellipsometric spectroscopy for studies in the visible and UV is recommended, along with electrocapillary thermodynamics, the zero charge potential as a parameter, spectroscopy, and the formation of a quantum electrochemical framework. Experimental methods are needed for measuring individual ionic concentrations 10-100 mm from the solid surface, and to determine the structure of H2O at the doublelayer Adsorption at the S-L interface is examined by sweep methods which expose the effects of varying the current and the potential. Present methods for studying the diffuse layer are limited to concentrations of 0.001 M or below. Monte Carlo techniques are needed at higher particle numbers. M.S.K.

A82-35506
OVERVIEW OF THE CURRENT STATUS OF SOLID-GAS INTERFACE SCIENCE
R. S. HANSEN (U.S. Department of Energy. Ames Laboratory, Ames, IA) (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 65-71. refs

The state-of-the-art in techniques for evaluating solid-gas interfaces is assessed, with an emphasis on processes relevant to solar technology. Electron and ion spectroscopy have aided in determining the interface chemical composition, although limitations due to vacuum requirements and surface effects, such as a variation of chemical composition with depth. Uncertainties can then result in a chemical analysis based on the kinetic energy of an emitted electron, which must pass through the inhomogeneously composed layers. The S-G interface techniques are applied to solar cell formation by modeling the optimum thicknesses and compositions of layers of built-up cells. Further use could be made in determining the changes in surface elements with time. M.S.K.

A82-35507
LIMITATION OF EXPERIMENTAL CAPABILITIES FOR INTERFACIAL STUDIES
D. LICHTMAN (Wisconsin, University, Milwaukee, WI) (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 73-79. refs

Surface analysis techniques for evaluating the interfacial areas in solar cells, mirrors, flat plates, etc. are reviewed. Auger electron spectroscopy is employed for solid-gas and solid-solid interface studies but can cause changes in the surface composition. Ion probes similarly can cause destruction of the substrate. Surface morphology is investigated with scanning electron microscopy up to a resolution of 10 nm. In all cases additional techniques are necessary to measure the exact location of beam traverse. The identification of neighboring components and lateral distributions depends on the use of low energy excitation diffraction, extended X ray fine structure spectroscopy, and electron energy loss spectroscopy. The development of techniques for exploring the distributions of individual atoms is indicated. M.S.K.

A82-35509
BASIC RESEARCH NEEDS AND OPPORTUNITIES AT THE SOLID-SOLID INTERFACE - DIFFUSION
P. W. BALLUFFI (MIT, Cambridge, MA), C. B. DUKE (Xerox Corp., Webster, NY), L. L. KAZMERSKI, K. W. MITCHELL (Solar Energy Research Institute, Golden, CO), R. REIFENBERGER (Purdue University, West Lafayette, IN), and R. F. WOOD (Oak Ridge National Laboratory, Oak Ridge, TN) (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 93-102. refs

The generic problems associated with solar materials solid-solid (S-S) interfaces are reviewed, and goals and techniques for ameliorating the deficiencies are outlined. Photovoltaic, photothermal, and photochemical devices considered are flat plate collectors, thin film Si cells, concentrator systems and compound cells, and polycrystalline systems. Exposure to thermal stresses, electric and radiation fields, chemicals and abrasives during the lifetime of solar cells is expected to create electric, optical, and thermal property changes in the material. Diffusion may also occur in S-S interfacial areas, and determination of the effects on the cells can presently be done using electron microscopy for examining the fine structure, diffraction pattern analysis for the interface structure, and scanning transmission electron microscopy to trace the chemical composition. Additional studies are needed to define the atomic and chemical exchange rates to establish the economic feasibility of low cost cells. M.S.K.

A82-35510
BASIC RESEARCH NEEDS AND OPPORTUNITIES AT THE SOLID-LIQUID INTERFACE
F. A. CAFASSO (Argonne National Laboratory, Argonne, IL), J. O. BOCKRIS (Texas A & M University, College Station, TX), S. G. DAVISON (Texas, University, Richardson, TX), T. E. FURTAK (Rensselaer Polytechnic Institute, Troy, NY), L. A. HELDT (Michigan Technological University, Houghton, MI), M. L. KNOTEK (Sandia National Laboratory, Albuquerque, NM), J. J. TRUHAN (California, University, Livermore, CA), J. R. WEEKS (Brookhaven National Laboratory, Upton, NY), and L. J. WITTENBERG (Monsanto Research Corp., Miamisburg, OH) (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 103-112. refs

Solid-liquid (S-L) interactions in photoelectrochemical and photoelectrosynthetic devices, the causes and forces of degradation, and the means to study the phenomena are reviewed. Improvements are asserted to be necessary in theoretical modeling, particularly in the fields of double layer theory and kinetic electrochemistry. It is suggested that the electrolyte be treated as a lattice gas, and that the theory of liquid mixtures be employed to find a pair correlation function on which an electronic theory of the electrolyte can be based. Research is recommended to concentrate on modified electrode materials and surfaces, thin film electrodes, and photo-assisted synthesis and electrocatalysis. Specific phenomena to be examined are discussed. M.S.K.

A82-35511
BASIC RESEARCH NEEDS AND OPPORTUNITIES AT THE SOLID-GAS INTERFACE
M. B. BRODSKY (Argonne National Laboratory, Argonne, IL), J. V. CATHCART (Oak Ridge National Laboratory, Oak Ridge, TN), R. S. HANSEN, K. L. KLIEWER (U.S. Department of Energy, Ames Laboratory, Ames, IA), U. LANDMAN (Georgia Institute of Technology, Atlanta, GA), R. L. PARK (Maryland, University, College Park, MD), and S. R. SHATYNSKI (Rensselaer Polytechnic Institute, Troy, NY) (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 113-124. refs

Solar energy conversion technologies which involve a solid-gas (S-G) interface in formation or operation and the means to study the related phenomena are reviewed, including thermoelectric and thermionic conversion. The analyses are considered as necessary for characterizing glasses, mirrors, heat mirrors, and transmitters using thermo- and photochromic modeling. Research is indicated on the glass-air interface, the air-solid interface encountered by antireflective coatings, the kinetics, and mechanisms of polymer degradation, and the development of new reflective materials. Absorber materials are explored, along with alternatives such as textured surfaces. Processes of formation, protection, and degradation of solar cells, particularly low cost thin-film devices, are explored, along with junction reaction and decomposition studies of thermoelectric devices and reactions of alkali metal vapors with thermionic devices. M.S.K.

A82-35513
BASIC RESEARCH NEEDS AND OPPORTUNITIES IN THIN FILMS AND COATINGS
J. R. ARTHUR (Perkin-Elmer Corp., Physical Electronics Div., Eden Prairie, MN), R. F. BUNSHAH (California, University, Los Angeles, CA), P. J. CALL (Solar Energy Research Institute, Golden, CO), J. E. GREENE (Illinois, University, Urbana, IL), M. G. LAGALLY (Wisconsin, University, Madison, WI), D. M. MATTOX, P. S. PEERCY (Sandia National Laboratory, Albuquerque, NM), J. OGALLAGHER (Chicago, University, Chicago, IL), W. T. PAWLEWICZ (Battelle Pacific Northwest Laboratories, Richland, WA), B. O. SERAPHIN (Arizona, University, Tucson, AZ) et al. (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 137-148.

The effects of basic research into the processing techniques for thin film solar cells on the costs and operating life of the finished product are considered. The use of reflection high energy electron diffraction, low energy electron diffraction, extended X ray fine structure diffraction, and field ion microscopy, along with IR or Raman scattering to examine the structural, chemical, and optical or electronic properties of single crystal and polycrystalline solar cells are explored. Research on vapor deposition rates and molecular beam epitaxy is recommended to be directed toward improving process control. Additional attention is given to physical vapor and chemical vapor deposition processes and the role of in situ measurements. Finally, studies in mechanical, atomic, chemical, and thermal degradation mechanisms are indicated. M.S.K.

A82-35514
BASIC RESEARCH NEEDS AND OPPORTUNITIES FOR CHARACTERIZING THE MICROSTRUCTURE AND MICROCHEMISTRY OF INTERFACES
J. SILCOX (Cornell University, Ithaca, NY), P. H. HOLLOWAY (Florida, University, Gainesville, FL), K. R. LAWLESS (Virginia, University, Charlottesville, VA), D. LICHTMAN (Wisconsin, University, Milwaukee, WI), R. G. MEISENHEIMER (California, University, Livermore, CA), L. E. MURR (Oregon Graduate Center, Beaverton, OR), and C. J. POWELL (National Bureau of Standards, Surface Science Div., Washington, DC) (U.S. Department of Energy, Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials, Denver, CO, June 30-July 3, 1980.) Materials Science and Engineering, vol. 53, Apr. 1982, p. 149-162. refs

Research areas for modeling the microcharacteristics of the solid-solid (S-S), solid-liquid (S-L), and solid-gas (S-G) interfaces formed in the fabrication and operation of solar energy conversion devices are identified, along with appropriate methods and instrumentation. Analytical electron microscopy offers the possibility of adequately defining surface topography at materials interfaces. Other techniques for characterizing the behavior of solar materials under changing environmental conditions and over longer periods of time are outlined, noting the necessity of in situ studies to enhance the ability to predict device stability over a thirty-year lifetime. Analyses are described for solar mirrors, absorbers, and photovoltaics, with distinction being made between degradation mechanisms inherent in fabricating the systems and during operation. M.S.K.

A82-35608#
MILITARY IMPLICATIONS OF A SATELLITE POWER SYSTEM
J. P. VAJK (Science Applications, Inc., Pleasanton, CA), R. D. STUTZKE (Science Applications, Inc., Colorado Springs, CO), R. SALKELD, G. W. DRIGGERS, and G. H. STINE In: Space manufacturing 4; Proceedings of the Fifth Conference, Princeton, NJ, May 18-21, 1981. New York, American Institute of Aeronautics and Astronautics, 1981, p. 77-87. Research supported by the U.S. Department of Energy. refs

If a satellite power system (SPS), such as is described in the NASA Reference Design Report, were to be undertaken to provide significant quantities of power to the United States and perhaps to other countries as well, significant military implications would ensue. These would arise, first, from the possible uses of such satellites and supporting systems as weapons or as supportive elements of other military systems, and, second, from the necessity of ensuring the security of such important economic assets in space. This paper summarizes some of the highlights of an extensive assessment of the military threats posed by SPS, the vulnerabilities of the Reference Design SPS, and potential safeguards against these threats and vulnerabilities. It is found that no threat issues have been revealed which cannot be mitigated by a judicious combination of safeguards. B.J.

A82-35637#
POWDER METALLURGY IN SPACE MANUFACTURING
D. R. CRISWELL In: Space manufacturing 4; Proceedings of the Fifth Conference, Princeton, NJ, May 18-21, 1981. New York, American Institute of Aeronautics and Astronautics, 1981, p. 389-398. refs

Manufacturing processes adaptable for use in space and processes suggested specifically for space production are reviewed with emphasis on the use of powder metallurgy techniques. The key physical processes of powder metallurgy, i.e., powder atomization, hot sintering, and cold welding, are discussed, and a minimum set of production tools (starting kit) which utilizes powdered materials technology is proposed. The starting kit uses solar energy and common lunar materials to produce a wide range of higher order tools of production and products. Two approaches to the production of parts from the powder are examined: the impact molder concept and metal and ceramic clay approach with the use of recoverable binder. V.L.

A82-35716
EVIDENCE FOR HOT-ELECTRON INJECTION ACROSS P-GAP/ELECTROLYTE JUNCTIONS
J. A. TURNER and A. J. NOZIK (Solar Energy Research Institute, Golden, CO) Applied Physics Letters, vol. 41, July 1, 1982, p. 101-103. refs
(Contract EG-77-C-01-4042)

Evidence has been obtained for hot-electron injection from illuminated p-GaP photocathodes into nonaqueous electrolyte containing anthracene as the electron acceptor. The position of the conduction-band edge at the electrolyte interface has been unequivocally established from Mott-Schottky plots in the dark and under illumination; no band-edge movement occurs during the experiment. The observed supraband-edge reduction of anthracene occurs with a hot-electron energy of 0.9 eV. (Author)

A82-35816
THEORY OF PHOTOCURRENT IN SEMICONDUCTOR-ELECTROLYTE JUNCTION SOLAR CELLS
F. EL GUIBALY and K. COLBOW (Simon Fraser University, Vancouver, Canada) Journal of Applied Physics, vol. 53, Mar. 1982, p. 1737-1740. refs

Expressions are derived for the current-voltage characteristics of semiconductor-electrolyte junctions. Charge transfer kinetics, surface recombination, recombination in the quasi-neutral region and in the depletion region as well as the effect of the incident illumination on the minority carrier distribution in the semiconductor are included in the model. It is shown that surface transfer velocity for minority carriers is a very important parameter that determines the photocurrent of the cell. The dependence of the photoresponse on the light intensity is shown to be a diagnostic tool in determining the efficiency of charge transfer at the surface. (Author)

A82-35886
HOLOGRAPHY CREATES NEW BREED OF OPTICAL COMPONENTS
H. BRODY High Technology, vol. 2, July-Aug. 1982, p. 68-73.

Applications of holographic optical elements are discussed. The construction and reconstruction of surface relief and volume holograms is explained along with the advantages and drawbacks of each. The most important military use of holograms is for improved head-up displays that would not obstruct the pilot's view of the real world and would have a larger field of view than present displays. Another promising field for holograms is scanning lasers, where a rotating disk covered with holograms efficiently substitutes for a spinning multifaceted mirror. Such scanning systems are being used in point-of-sale checkout systems and in text printers. Other promising hologram uses include efficient solar trackers for solar energy production, holographic 'window shades' for energy conservation, and the carrying of light beams of different wavelength on a single optical fiber. C.D.

A82-35918
CALCULATING THE SOLAR CONTRIBUTION TO SOLAR ASSISTED SYSTEMS
J. P. GEROFI, E. MANNIK, and G. G. FENTON (Sydney, University, Sydney, Australia) Solar Energy, vol. 28, no. 5, 1982, p. 377-383. refs

After summarizing the methods for calculating the solar contribution for systems without thermal storage, this paper extends a previously proposed method which is based on using a frequency distribution of insolation data. This extension allows rapid hand calculation of solar contribution for most collector types and for any specified collector inlet and outlet temperatures. Typical results are shown to be accurate to within 1 per cent relative to dynamic computer simulation methods. The effect on the method of collector orientation and tilt is discussed, and a simple method of determining the maximum possible (i.e., infinite collector area) solar contribution for a given collector system is described. (Author)

A82-35920
SOLAR ENERGY CONVERSION AND STORAGE THROUGH SYNTHETIC LIGHT-DRIVEN PROTON PUMPS
G. W. MURPHY, M. F. LEMONS, and M. M. SPRINGER (Oklahoma, University, Norman, OK) Solar Energy, vol. 28, no. 5, 1982, p. 403-406. NSF-supported research.

Two approaches to the conversion and storage of solar energy through synthetic light-driven proton pumps are discussed and experimental data on model systems are presented. The more promising of these is photoelectrodialytic acid-base production from salt in the charge half cycle and reversible recombination of acid and base to yield electric power in the discharge half cycle. The second method continues previous studies on photochemically induced pH changes in thionine-metal ion systems with improved, though not yet practical, results. (Author)

A82-35921
PERFORMANCE TEST OF SOLAR COLLECTOR WITH INTERMITTENT OUTPUT
B. J. HUANG and J. H. LU (National Taiwan University, Taipei, Republic of China) Solar Energy, vol. 28, no. 5, 1982, p. 413-420. National Science Council of the Republic of China refs
(Contract NSC-69E-0401-02(04))

A solar flat plate collector system which employs a solenoidal valve installed at the exit of the collector to control the hot-water flow is described. A sensor in the solenoid detects a sufficient temperature in the water and orders the valve opened. Inflowing colder water causes the valve to reshut, thus maintaining hot water in the system loop. The energy balance of the system was modeled numerically and a collector outfitted with the solenoid switch was tested in conjunction within a storage tank application. Measurements were made with varying collector tilts, the outflow mass for each cycle, the average efficiency, and the intermittent period output. Good qualitative correlations were observed between the predicted and measured performance of the system. M.S.K.

A82-35922
THE RATES OF SOLAR ENERGY STORAGE AND RETRIEVAL IN A ZEOLITE-WATER SYSTEM
R. GOPAL, B. R. HOLLEBONE, C. H. LANGFORD, and R. A. SHIGEISHI (Carleton University, Ottawa, Canada) Solar Energy, vol. 28, no. 5, 1982, p. 421-424. Department of Supply and Services
(Contract DSS-07SU-3115-9-2682)

The salient features that determine the possible use of a water vapour-zeolite 13X system as a method of energy storage were investigated. Cycling studies over two months revealed no decrease in water capacity nor any structural deterioration. The rate at which water could be desorbed in a static situation was determined at various temperatures from 110 to 250 C. The adsorption isotherm and the heats of adsorption as a function of amount of adsorbed water were determined. The saturation capacity was 0.33 g H2O/g zeolite while the heat of adsorption declined from 90 to 50 kJ kJ/mol. The rate of heat development was found to be very high so that heat extraction from the store would not be a problem in any practical utilization of this system. (Author)

A82-36117
TWO-ELEMENT CASCADE AL-GA-AS SOLAR CELL
ZH. I. ALFEROV, V. M. ANDREEV, N. S. ZIMOGOROVA, O. O. IVENTEVA, and V. I. MYRZIN (Pis'ma v Zhurnal Tekhnicheskoi Fiziki, vol. 7, July 26, 1981, p. 833-836.) Soviet Technical Physics Letters, vol. 7, July 1981, p. 357, 358. Translation. refs

Monolithic cascade solar cells in which each cell is used as an independent power supply have been fabricated by liquid-phase epitaxy on GaAs substrates in the (100) orientation. The monolithic cascade solar cells consist of two photocells: (1) the upper cell with a p-n junction in Al(y)Ga(1-y)As and a protective window of Al(x)Ga(1-x)As, where x is 0.9 or more and (2) the lower cell with a p-n junction in gallium arsenide, for which an Al(y)Ga(1-y)As solid solution serves as a window. The efficiency of a monolithic cascade structure with a gap width of 1.65 eV, fabricated in a

single technological process, is 18%, i.e. twice the efficiency reported previously for a GaAs-AlAs cascade cell. V.L.

A82-36163
GERMANIUM SELECTIVE SOLAR ABSORBER SURFACES
P. P. THOGERSEN, F. H. COCKS, P. L. JONES (Duke University, Durham, NC), and J. T. A. POLLOCK Journal of Materials Science, vol. 17, May 1982, p. 1377-1380. refs

Thin Ge films, produced by evaporation through 0.3, 1 and 3 torr pressures of argon onto polished aluminum substrates were found to exhibit selective absorption behavior. Maximum absorptance to emittance ratios of 13:1 were measured, with values of 8:1 for films having solar absorptances of 0.9. Film structures were significant in determining collection efficiency. Films deposited at 0.3 torr showed better overall properties due to a larger particle size of about 1 micron compared with an approximate 0.1 micron size measured with films deposited at 1 and 3 torr. (Author)

A82-36208
HEAT LOSS FACTOR FOR LINEAR SOLAR CONCENTRATORS
S. C. MULLICK and S. K. NANDA (Indian Institute of Technology, New Delhi, India) Applied Energy, vol. 11, May 1982, p. 1-13. refs

Numerical techniques are developed for calculating the heat loss factor through the glass cover of a cylindrical solar concentrator. The configuration considered was a steel tube suspended in the central space of a concentric glass tube. Heat transfer coefficients were determined for both the radiative heat between the tube and the glass and the convective heat transfer within the medium between the steel and the glass. The sum of the two coefficients is treated as the total heat transferred to the outside air by forced or mixed convection. Correlations of the outside to inside heat transfer resistances ratio to the wind velocity, the absorber temperature, the emittance of black paint, etc. were formulated. The results are noted to be applicable to flat plate collectors and useful for manufacturers of solar equipment.
M.S.K.

A82-36210
CHEMICALLY SPRAYED PBS COATINGS FOR PHOTOTHERMAL SOLAR ENERGY CONVERSION. R. C. AGARWAL AND P. K. C. PILLAI [INDIAN INSTITUTE OF TECHNOLOGY, NEW DELHI, INDIA]
Applied Energy, vol. 11, May 1982, p. 61-68. refs

This paper reports on an investigation into the optical and physical properties of PbS coatings prepared by spray pyrolysis onto chemically brightened aluminum substrates. The advantages are low cost, reasonably good selectivity and the coatings' ability to be scaled onto collectors of any desired size. The coatings exhibit a high absorptivity in the solar range and a low emissivity in the thermal range. Finally, the photothermal conversion efficiencies of black paint-coated and PbS-coated solar collectors are compared. (Author)

A82-36215
ZAP - INTRODUCING THE ZERO-BIAS AVALANCHE PHOTODIODE
T. P. PEARSALL (Bell Telephone Laboratories, Inc., Murray Hill, NJ) Electronics Letters, vol. 18, June 10, 1982, p. 512-514. refs

A novel heterostructure p-n junction diode is described which provides a photocurrent gain of 2 under zero external bias conditions. The necessary energy required to produce the additional electron-hole pair would be supplied by the internal electric field associated with the heterojunction energy gap difference. The ZAP diode structure has energy conversion applications as a photovoltaic detector whose efficiency may be enhanced by as much as 25% over that obtainable using homojunction solar cells. The device has, however, yet to be built. (Author)

A82-36227
AS-DEPOSITED CVD AMORPHOUS SILICON FILMS FOR SOLAR PHOTOVOLTAIC APPLICATIONS
S. V. KOINOV, L. V. VASILEV, L. K. MLADZHOV, and S. K. KANEV (Bulgarian Academy of Sciences, Solar Energy and New Energy Sources Laboratory, Sofia, Bulgaria) Bolgarskaia Akademiia Nauk, Doklady, vol. 35, no. 2, 1982, p. 161-164. refs

Amorphous silicon films were deposited by the pyrolytic decomposition of silane at atmospheric pressure. They exhibited conductive and photoconductive properties similar to those inherent to glow-discharge amorphous Si:H alloys and sputtered in Ar-H plasma. A model of the possible hydrogenation of the material is presented. (Author)

A82-36263* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FRACTURE OF DIRECTIONALLY SOLIDIFIED MULTICRYSTALLINE SILICON
C. P. CHEN, M. H. LEIPOLD, JR. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and D. HELMREICH (Heliotronic GmbH, Burghausen, West Germany) American Ceramic Society, Journal, vol. 65, Apr. 1982, p. C-49. Research supported by the U.S. Department of Energy; Bundesministerium fuer Forschung und Technologie refs
(Contract BMFT-NT-0845/0846)

Fracture toughness data is given for multicrystalline silicon which has been prepared by directional solidification. Results indicated a plane-strain fracture toughness of 0.8 to 0.87 MN/m to the 3/2 power, which is consistent with data for single-crystal silicon. (Author)

A82-36750
THERMAL AND PHOTOCHEMICAL STUDIES OF SOLAR ENERGY ABSORBERS DISSOLVED IN HEAT TRANSFER FLUIDS
A. R. BURKE, D. E. ETTER, C. R. HUDGENS, C. J. WIEDENHEFT, and L. J. WITTENBERG (Monsanto Research Corp., Miamisburg, OH) Solar Energy Materials, vol. 6, May-June 1982, p. 481-490. refs
(Contract DE-AC04-76DP-00053)

Thermal stability, photochemical stability and optical absorptivity at elevated temperatures of various heat transfer fluids containing chromophoric materials were studied. Eight chromo

A82-36863
SPRAY-DEPOSITED SNO2/N-SI/POLYCRYSTALLINE/ SOLAR CELLS
A. BHARDWAJ, K. S. KALONIA, A. RAZA, A. K. SHARMA, B. K. GUPTA, and O. P. AGNIHOTRI (Indian Institute of Technology, New Delhi, India) Solar Cells, vol. 5, Apr. 1982, p. 305-311. Research supported by the Ministry of Industrial Development of India. refs

In response to recent interest in the development of semiconductor-insulator-semiconductor solar cells, which obviate high temperature processing, SnO2/n-Si solar cells were fabricated by the spray deposition of SnO2 onto n-type polycrystaline silicon of 0.1-1 ohm cm resistivity. The thickness of the chemically grown interface layer is estimated to be 18 A, and capacitance-voltage measurements indicate a barrier height of 0.68 V. The performance parameters of this heterojunction solar cell include: (1) an 0.452 V open circuit voltage; (2) a 19.7 mA/sq cm current density; (3) an 0.634 fill factor; and (4) a conversion efficiency of 7.06% at an illumination of 80 mW/sq cm. O.C.

A82-36864
CZOCHRALSKI SILICON SOLAR CELL MODULES - PRESENT COST AND FUTURE PROSPECTS
R. M. MOORE (Solar Energy Research Institute, Golden, CO; Chevron Research Corp., Solar Div., Richmond, CA) Solar Cells, vol. 5, Apr. 1982, p. 313-329. refs

A multipath learning curve model of the development of the Czochralski process silicon solar cell industry is first tested through application of historical data for the 1974-1979 period, and upon

confirmation of its ability to predict price dynamics is used to forecast production costs in 1980-1985. The 1985 forecasts, in 1979 U.S. dollars, are $2.2/peak W at 10% estimated confidence level, $3.1-3.2/peak W at 50% estimated confidence level and $4.8/peak W at 90% estimated confidence level. It is concluded in light of these estimates that the 1985 state of development of the Czochralski silicon solar cell industry does not represent an attractive investment for major companies presently involved in related work, while a very attractive market is presented for small companies which are already participating in production. The resource base of small companies, however, is insufficient to support the investment levels required in 1980-1985. A primary consequence of this research is that the choice of the wafer or ribbon form of silicon crystal material chosen for intensive development is less important than the research and development emphasis which must be placed on the reduction of high purity polycrystalline silicon feedstock costs. O.C.

A82-36865
CONDUCTOR-INSULATOR-SEMICONDUCTOR ORGANIC SOLAR CELLS
R. O. LOUTFY, Y.-H. SHING, and D. K. MURTI (Xerox Research Centre of Canada, Mississauga, Ontario, Canada) Solar Cells, vol. 5, Apr. 1982, p. 331-341. refs

A new class of conductor-insulator-semiconductor (CIS) organic solar cells has been developed, whose novel features include the application of a transparent, conductive front electrode and a thin insulating layer. The selection of the front electrode divides CIS organic cells into three configurations: (1) a metal-insulator-semiconductor cell having a metal front electrode; (2) a semiconductor-insulator-semiconductor cell having a degenerate semiconductor electrode; and (3) an electrolyte-insulator-semiconductor cell using electrolytic contact. The barrier formation in the base organic semiconductor is determined by the work function of the transparent conductive electrode. The material used in the present study for the base semiconducting layer is an X-phase, metal-free phthalocyanine-polymer binder combination which can be deposited onto a substrate by solution casting. O.C.

A82-36867
EFFECTIVE DRIFT CURRENT DENSITIES IN THE N-TYPE HEAVILY DOPED EMITTER REGION OF P-N/PLUS/ JUNCTION SILICON SOLAR CELLS
H. V. CONG and S. BRUNET (Perpignan, Universite, Perpignan, France) Solar Cells, vol. 5, Apr. 1982, p. 355-365. refs

A82-36868
ANALYTICAL EXPRESSIONS FOR THE DETERMINATION OF THE MAXIMUM POWER POINT AND THE FILL FACTOR OF A SOLAR CELL
G. L. ARAUJO and E. SANCHEZ (Escuela Tecnica Superior de Ingenieros de Telecomunicacion, Madrid, Spain) Solar Cells, vol. 5, Apr. 1982, p. 377-386. Research supported by the Ministry of Industry and Energy. refs

A82-36869
A COMMENT ON THE GENERALIZATION OF THE THEORETICAL BASIS OF PHOTOVOLTAIC CONCENTRATORS FOR EXTENDED LIGHT SOURCES
A. LUQUE (Escuela Tecnica Superior de Ingenieros de Telecommunicacion, Madrid, Spain) Solar Cells, vol. 5, Apr. 1982, p. 387-389.

Maximum optical concentration is achieved by a solar cell collector when it is illuminated isotropically, with the concentrator oriented in such a way that solar source area, A(s)-prime, equals the area of highest energy collection, A(s). It is shown that the A(s)-prime/A(s) orientation factor permits the application of the theory proposed by Luque (1981) to concentrators which are not optimally oriented, such as asymmetric concentrators, with emphasis on errors that could arise from not using the orientation factor. O.C.

A82-37116#
DEVELOPMENT EFFORT OF SHEET MOLDING COMPOUND /SMC/ PARABOLIC TROUGH PANELS
P. A. KIRSCH (Budd Co., Ft. Washington, PA) and R. L. CHAMPION (Sandia National Laboratory, Albuquerque, NM) In: Reinforced Plastics/Composites Institute, Annual Conference, 36th, Washington, DC, February 16-20, 1981, Preprints. New York, Society of the Plastics Industry, Inc., 1981 (Session 26-C). 4 p. Research supported by Sandia National Laboratory.

Technical considerations at efforts to develop parabolic solar reflectors using sheet molding compounds with glass reflectors molded into the troughs are described. Strengthening of mirrored glass sheets followed by application of an adhesive was found to provide good protection for both the silvered back of the mirror and the sheet molding compound after the two were joined in a single press stroke of a compression molding process. Details of the prototype one meter wide troughs with a 19.01 in. focal length are provided, including design solutions such as three external ribs joined to two external coaming ribs to provide the required stiffness. Changes in the size of the sheet molding after curing and in cooling to room temperature were accounted for by modeling with an appropriate standard deviation, and fabricating the trough panel mold to a smaller focal length, 18.95 in. Prospects for transferring the techniques to mass production are considered favorable. M.S.K.

A82-37438
DESIGN OF A SYSTEM FOR SOLAR ENERGY STORAGE VIA WATER ELECTROLYSIS
A. KOUKOUVINOS, V. LYGEROU, and N. KOUMOUTSOS (Athens, National Technical University, Athens, Greece) International Journal of Hydrogen Energy, vol. 7, no. 8, 1982, p. 645-650. refs

The design and economic evaluation of a system that provides electricity for an average one-family dwelling by utilizing solar energy are detailed. Solar energy is converted by photovoltaic arrays to electricity which is then used for the electrolysis of water. The hydrogen produced is stored in the form of hydride and can be used either for direct burning, to meet the thermal energy requirements, or in a fuel cell to supply the electric energy needed. Particular emphasis was given to designing a control system that could guarantee a smooth intermittent operation of the electrolytic unit and the utilization of the maximum output of the photovoltaic cells. The system selected can operate with minimum attendance and very little maintenance. The cost of the electricity produced is as high as $3.30/kWh. (Author)

A82-37588
DETERMINATION OF THE STAGNATION TEMPERATURE OF FLAT PLATE SOLAR COLLECTORS [BESTIMMUNG DER STILLSTANDTEMPERATUR VON FLACHKOLLEKTOREN]
K. MASSMEYER (Kernforschungsanlage Juelich GmbH, Institut fuer Kernphysik, Juelich; Koeln, Universitaet, Cologne, West Germany), J. W. GRUETER, H. D. TALAREK (Kernforschungsanlage Juelich GmbH, Institut fuer Kernphysik, Juelich, West Germany), and E. RASCHKE (Koeln, Universitaet, Cologne, West Germany) Meteorologische Rundschau, vol. 35, June 1982, p. 67-75. In German. refs

For the safe operation of collector systems, it is necessary to determine the highest temperature which can occur in the collector for conditions under which no energy is withdrawn from the collector. A description is presented of a method which makes it possible to determine this temperature. The considered method does not depend on the meteorological conditions, and provides also values regarding the temperature dependence of the heat transmission coefficient of flat plate collectors. Global insolation is found to have the greatest effect on the stagnation temperature. Fluctuations in wind velocity between 0 and 5 m/s produce approximately the same variations in stagnation temperature as changes of the environmental temperature from -10 C to +40 C. The contribution provided by diffuse insolation is nearly one order of magnitude less. G.R.

A82-37629
TERNARY CHALCOGENIDE-BASED PHOTOELECTROCHEMICAL CELLS. II - THE N-CDIN2SE4/AQUEOUS POLYSULFIDE SYSTEM
R. TENNE, Y. MIROVSKY, Y. GREENSTEIN, and D. CAHEN (Weizmann Institute of Science, Rehovot, Israel) Electrochemical Society, Journal, vol. 129, July 1982, p. 1506-1512. Research supported by the U.S.-Israel Binational Science Foundation. refs

The behavior of CdIn2Se4, a ternary analog of CdSe, as a photoanode in an aqueous polysulfide photoelectrochemical cell is investigated. Measurements of I-V curves in the dark and under illumination show that potentiostatic photoetching under large reverse bias leads to a dramatic increase in cell photocurrent (up to about 15 mA/sq cm under reverse bias of 400 mV) and a decrease in the dark currents under reverse bias as well as an improvement in output stability. Spectral response measurements reveal a considerable subbandgap photocurrent for the etched electrode, most of which disappears after photoetching, accompanied by an order of magnitude increase in the response to supra-bandgap excitation. Analysis of the shape of the spectral response reveals two distinct transition modes: an indirect transition at 1.55 eV and a direct transition at 1.72 eV. Finally, preliminary tests on thin film polycrystalline electrodes demonstrate an encouraging performance for polycrystalline material. A.L.W.

A82-37633
THE ROLE OF BE IN /GAAL/AS/GAAS SOLAR CELLS
K. MASU, S.-I. NAKATSUKA, M. KONAGAI, and K. TAKAHASHI (Tokyo Institute of Technology, Tokyo, Japan) Electrochemical Society, Journal, vol. 129, July 1982, p. 1623-1627. refs

The diffusion and doping behavior of Be in (GaAl)As/GaAs solar cells are investigated. Be diffusion into n-GaAs was followed during the LPE growth of Be-doped Ga(0.2)Al(0.8)As layers on the n-GaAs substrate at initial growth temperatures of 700 to 900 C, cooling rates from 0 to 0.5 C/min, growth durations of 10 to 120 min, and dopant concentrations from 0.01 to 0.3 at. %. The thickness of the Be-diffused p-GaAs region is found to increase with increasing growth temperature, leading to an exponential form for the dependence of the diffusion coefficient on temperature. The diffusion coefficient is also found to be proportional to the beryllium concentration in the growth melt. Measurements demonstrate the resistivity of Be-doped p-Ga(0.2) Al(0.8)As to be about 10 times higher than that of Be-diffused p-GaAs, with an acceptor energy level for Be in Ga(0.2)Al(0.8)As of 47 meV. An electron diffusion length of 4.3 microns was measured in p-GaAs at an average free-carrier concentration of about 10 to the 18th/cu cm. Finally, measurements of the photovoltaic characteristics of beryllium-doped (GaAl)As/GaAs p-p-n solar cells reveal a conversion efficiency in excess of 20% (AM1) and a peak output power of about 5 W/sq cm at 400 suns. A.L.W.

A82-37634
P-TYPE AMORPHOUS SILICON/LIQUID JUNCTION SOLAR CELL
W. M. AYERS (Exxon Research and Engineering Co., Linden, NJ) Electrochemical Society, Journal, vol. 129, July 1982, p. 1644-1646.

The characteristics of p-type amorphous silicon, a low-cost material under consideration for use for the photoelectrodes of a liquid junction solar cell, and of such a cell based on this material, are investigated. Measurements of the decrease in cell photovoltage as the aqueous vanadium electrolyte drifts to more oxidizing potentials indicate that although surface states are present, they do not act to pin the Fermi level of p-type amorphous silicon. Experiments demonstrate an open circuit voltage of 0.41 V, short circuit current of 0.18 mA/sq cm and fill factor of 0.3 when the electrolyte potential is driven to -0.51 V (vs SCE). An efficiency of 0.06% is obtained at 40 mW/sq cm illumination. The cell was also able to sustain a 1.3 microamp/sq cm current density for over an hour with no indication of failure, demonstrating the stability of the electrode. p-type amorphous silicon is thus concluded to be a promising material for thin-film photocathodes, with its major limitation the low short-circuit current. A.L.W.

A82-37671
PHYSICAL BASIS OF POWER CONVERSION OF ENERGY FLUCTUATIONS
J. C. YATER Physical Review A - General Physics, 3rd Series, vol. 26, July 1982, p. 522-538. refs

The power conversion of energy fluctuations is an alternate energy source with the potential, in principle, to achieve the maximum efficiency of the Carnot cycle. An analysis is conducted concerning the physical basis for the design of circuits to implement the considered approach. The reversible-energy-fluctuations (REF) converter first absorbs and converts thermal energy incoming by conduction, convection, or radiation into electric energy fluctuations in a first layer. The energy-transducing first layer and a thermal-barrier second layer provide a physical basis to achieve various goals for the power conversion of the energy fluctuations transferred to the diodes in a third layer. The goals include an efficiency approaching the Carnot limit for reversible operations, a much larger power output than provided in concentrated solar energy, less exacting material requirements, and a very wide temperature range of operation. G.R.

A82-37850
CURRENT-VOLTAGE RESPONSE OF TANDEM JUNCTION SOLAR CELLS
R. R. POTTER, J. R. SITES (Colorado State University, Fort Collins, CO), and S. WAGNER (Princeton University, Princeton, NJ) Journal of Applied Physics, vol. 53, July 1982, p. 5269-5272. refs
(Contract XF-1-1237-1)

A tandem cell is modeled and tested against experimental results. A planar structure is considered in which high energy photons are absorbed by an outer semiconductor material. The salient features of a straightforward model in which series resistance and leakage current are considered individually for the constituent cells are shown. The current superposition principle is used by taking the total current of a diode as the algebraic sum of dark and photocurrents, while charge trapping in bulk or interface states is neglected. The model is compared with experimental results from the 'monolithic' n-Si/SnO2/n-CdSe/electrolyte cell and with the two individual cells that constitute the tandem structure. Results show that much optimization may be carried out using each diode separately, where thin films are supported on glass substrates. By using the individual J-V curves, obtained when the junctions are stacked in the light beam, one can predict the maximum tandem output. C.D.

A82-37851
PROPERTIES AND STRUCTURE OF A-SIC:H FOR HIGH-EFFICIENCY A-SI SOLAR CELL
Y. TAWADA, M. KONDO, H. OKAMOTO, Y. HAMAKAWA (Osaka University, Toyonaka, Japan), and K. TSUGE Journal of Applied Physics, vol. 53, July 1982, p. 5273-5281. Research supported by the Ministry of Education, Science, and Culture and Agency of Industrial Science and Technology. refs

A series of experimental investigations on optical and optoelectronic properties of methane and ethylene-based a-SiC:H films has been made. The chemical bonding structure of such films has also been explored with IR absorption structural analysis. An experimental verification for the wide gap window material in the amorphous silicon solar cell is shown for methane and ethylene-based a-SiC:H. The methane-based film shows a one or two orders of magnitude larger photoconductivity recovery effect resulting from doping than the ethylene-based one. IR absorption analysis shows that the methane-based a-SiC:H film is recognized as a rather ideal amorphous SiC alloy as compared with the ethylene-based one. It is found that the methane-based film is almost constructed with tetrahedrally coordinated carbons or carbons attached to a hydrogen, and is superior to the ethylene-based one for a window material in a p-i-n solar cell. C.D.

A82-37944
IONIZED IMPURITY INDUCED PHOTOCARRIER GENERATION IN ORGANIC ENERGY CONVERSION SYSTEMS
Z. D. POPOVIC (Xerox Research Centre of Canada, Mississauga, Ontario, Canada) Journal of Chemical Physics, vol. 77, July 1, 1982, p. 498-506. refs

The present study has the objective to investigate the influence of the discrete nature of ionized impurities in a Schottky barrier on the field dependent carrier generation of an organic photovoltaic cell. Attention is given to the influence of the local ionized impurity field on the carrier generation, compared to the influence of the average field in the barrier. It is assumed that exciton dissociation into electron-hole pairs can be adequately described as a function of the local electric field. The proposal is made that thermal regeneration of ionized impurities can lead to continuous charge production based on the proposed mechanism. The study has been motivated by a significant discrepancy observed between the measured and calculated carrier generation efficiencies in x-metal-free phthalocyanine photovoltaic cells. The proposed mechanism of ionized impurity-assisted carrier generation offers an explanation for the observed enhancement in x-metal-free phthalocyanine photovoltaic cells. G.R.

A82-37973#
CENTRAL SOLAR RECEIVERS - APPLICATIONS FOR UTILITIES AND INDUSTRY
P. A. CURTO (Gibbs and Hill, Inc., Washington, DC) and G. STERN Mechanical Engineering, vol. 104, July 1982, p. 54-57.

Two fundamentally different types of central solar receiver systems - molten salt and forced air systems - have been developed to the point of commercial demonstration. In the molten salt system, molten salt is heated to about 600 C and used to produce steam for power generation. The overall peak efficiency (sunlight to electricity) is approximately 23.2% using the molten salt concept, compared to 8-12% with photovoltaics. In the forced-air system, ambient air is inducted into speed-controlled gas turbines, forced through a metal tube receiver, heated to 600-816 C, and then expanded into several different turbines. The exhaust air can be utilized in various ways, depending on the downstream process conditions. A table of the combined cycle system performances for the forced-air system shows that the overall cycle efficiencies range from 35.6 to 37.4% (from heat to electricity), while when coupled with an annual average (sunlight-to-heat) collection efficiency of 54% in the air receiver, overall annual system efficiency ranges from 19.2 to 20.2%, with peak efficiency as high as 23.2%. Detailed diagrams of each of the two systems are given. The new generation of these plants have broad applications in new and retrofit utility and industrial facilities. The projected costs are competitive, even for first-generation plants. N.B.

N82-22652*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE 19TH PROJECT INTEGRATION MEETING Progress Report, Jul. - Nov. 1981
R. R. MCDONALD Nov. 1981 397 p refs
(Contract NAS7-100; DE-AI01-76ET-20356)
(NASA-CR-168822; JPL-PUB-82-11; DOE/JPL-1012-67; NAS 1.26:168822; PP-19) Avail: NTIS HC A17/MF A01 CSCL 10A

The Flat-Plate Solar Array Project is described. Project analysis and integration is discussed. Technology research in silicon material, large-area silicon sheet and environmental isolation; cell and module formation; engineering sciences, and module performance and failure analysis. It includes a report on, and copies of visual presentations made at, the 19th Project Integration Meeting held at Pasadena, California, on November 11, 1981. Author

N82-22653*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOLAR POND POWER PLANT FEASIBILITY STUDY FOR DAVIS, CALIFORNIA
Y. C. WU, M. J. SINGER, H. E. MARSH, J. HARRIS, and A. L. WALTON 15 Feb. 1982 73 p refs Prepared for the City of Davis, Calif.
(Contract NAS7-100)
(NASA-CR-168819; JPL-PUB-82-16; JPL-5107-4; NAS 1.26:168819) Avail: NTIS HC A04/MF A01 CSCL 10A

The feasibility of constructing a solar pond power plant at Davis, California was studied. Site visits, weather data compilation, soil and water analyses, conceptual system design and analyses, a material and equipment market survey, conceptual site layout, and a preliminary cost estimate were studied. It was concluded that a solar pond power plant is technically feasible, but economically unattractive. The relatively small scale of the proposed plant and the high cost of importing salt resulted in a disproportionately high capital investment with respect to the annual energy production capacity of the plant. Cycle optimization and increased plant size would increase the economical attractiveness of the proposed concept. R.J.F.

N82-22654*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SALTON SEA PROJECT, PHASE 1 Final Report
M. L. PEELGREN 15 Jan. 1982 129 p refs
(Contract NAS7-100; DE-AI01-79ET-20307)
(NASA-CR-168804; JPL-PUB-81-108; JPL-1060-54; JPL-5107-2; NAS 1.26:168804) Avail: NTIS HC A07/MF A01 CSCL 10A

A feasibility study was made for a salt gradient solar pond power plant in or near the Salton Sea of California. The conclusions support continuance 5-MWe proof-of-concept experiment, and ultimate construction by an electric utility company of a 600-MWe plant. The Solar Pond concept would be an environmental benefit to the Salton Sea by reversing the increasing salinity trend. The greatest cost drivers are the lake dike construction and pond sealing. Problems to be resolved include method of brine production from Salton Sea water for the first unit (which requires evaporation pond area and time), the high turbidity and color content of the Salton Sea water (which requires pretreatment), and other questions related to pond permeability, bio-activity and soil/brine chemical reactions. All technical and environmental problems appear solvable and/or manageable if care is taken in mitigating impacts. Author

N82-22656*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PHOTOVOLTAICS AS A TERRESTRIAL ENERGY SOURCE. VOLUME 2: SYSTEM VALUE
J. L. SMITH Oct. 1980 41 p refs 3 Vol.
(Contract NAS7-100; DE-A101-79CS-30315)
(NASA-CR-168809; JPL-PUB-81-103-VOL-2; JPL-5220-15; NAS 1.26:168809; DOE/ET-20356/6-VOL-2) Avail: NTIS HC A03/MF A01 CSCL 10A

Assumptions and techniques employed by the electric utility industry and other electricity planners to make estimates of the future value of photovoltaic (PV) systems interconnected with U.S. electric utilities were examined. Existing estimates of PV value and their interpretation and limitations are discussed. PV value is defined as the marginal private savings accruing to potential PV owners. For utility-owned PV systems, these values are shown to be the after-tax savings in conventional fuel and capacity displaced by the PV output. For non-utility-owned (distributed) systems, the utility's savings in fuel and capacity must first be translated through the electric rate structure (prices) to the potential PV system owner. Base-case estimates of the average value of PV systems to U.S. utilities are presented. The relationship of these results to the PV Program price goals and current energy policy is discussed; the usefulness of PV output quantity goals is also reviewed. M.D.K.

N82-22657*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PHOTOVOLTAICS AS A TERRESTRIAL ENERGY SOURCE. VOLUME 3: AN OVERVIEW
J. L. SMITH Oct. 1980 41 p refs 3 Vol.
(Contract NAS7-100; DE-AI01-79CS-30315)
(NASA-CR-168810; JPL-PUB-81-103-VOL-3; JPL-5220-15; NAS 1.26:168810; DOE/ET-20356/6-VOL-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Photovoltaic (PV) systems were evaluated in terms of their potential for terrestrial application A comprehensive overview of important issues which bear on photovoltaic (PV) systems development is presented. Studies of PV system costs, the societal implications of PV system development, and strategies in PV research and development in relationship to current energy policies are summarized. M.D.K.

N82-22660*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PHOTOVOLTAIC SYSTEMS TEST FACILITIES: EXISTING CAPABILITIES COMPILATION
K. VOLKMER 1 Mar. 1982 31 p
(Contract NAS7-100; DE-AI01-76ET-20356)
(NASA-CR-168802; JPL-PUB-14-REV-1; JPL-5240-3-REV-A; NAS 1.26:168802; DOE/ET-20456/1-REV-1) Avail: NTIS HC A03/MF A01 CSCL 10A

A general description of photovoltaic systems test facilities (PV-STFs) operated under the U.S. Department of Energy's photovoltaics program is given. Descriptions of a number of privately operated facilities having test capabilities appropriate to photovoltaic hardware development are given. A summary of specific, representative test capabilities at the system and subsystem level is presented for each listed facility. The range of system and subsystem test capabilities available to serve the needs of both the photovoltaics program and the private sector photovoltaics industry is given. R.J.F.

N82-22664*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REGIONAL APPLICABILITY AND POTENTIAL OF SALT-GRADIENT SOLAR PONDS IN THE UNITED STATES. VOLUME 1: EXECUTIVE SUMMARY
E. I. H. LIN 1 Mar. 1982 23 p 2 Vol.
(Contract NAS7-100; DE-AI03-81SF-11552)
(NASA-CR-168805; JPL-PUB-82-10-VOL-1; DOE/JPL-1060-50-VOL-1; JPL-5107-1-VOL-1; NAS 1.26:168805) Avail: NTIS HC A02/MF A01 CSCL 10A

Findings of a survey concerning salt ponds are summarized. The residential, commercial, and institutional buildings sector is discussed. The industrial process heat sector is considered. The agricultural process heat sector is examined. The electrical power sector is reviewed. The desalinization sector is considered. N.W.

N82-22665*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REGIONAL APPLICABILITY AND POTENTIAL OF SALT-GRADIENT SOLAR PONDS IN THE UNITED STATES. VOLUME 2: DETAILED REPORT
E. I. H. LINet al. 15 Mar. 1982 500 p refs 2 Vol.
(Contract NAS7-100; DE-AT04-80AL-13135)
(NASA-CR-168806; JPL-PUB-82-10-VOL-2; JPL-5107-1-VOL-2; DOE/JPL-1060-50-VOL-2; NAS 1.26:168806) Avail: NTIS HC A21/MF A01 CSCL 10A

A comprehensive assessment of the regional applicability and potential of salt-gradient solar ponds in the United States is provided. The assessment is focused on the general characteristics of twelve defined geographic regions. Natural resources essential to solar ponds are surveyed. Meteorological and hydrogeological conditions affecting pond performance are examined. Potentially favorable pond sites are identified. Regional thermal and electrical energy output from solar ponds is calculated. Selected pond design cases are studied. Five major potential market sectors are evaluated in terms of technical and energy-consumption characteristics, and solar-pond applicability and potential. Relevant pond system data and financial factors are analyzed. Solar-pond energy costs are compared with conventional energy costs. The assessment concludes that, excepting Alaska, ponds are applicable in all regions for at least two market sectors. Total solar pond energy supply potential in the five market sectors examined is estimated to be 8.94 quads/yr by the year 2000, approximately 7.2% of the projected total national energy demand. Author

N82-22668# Midwest Research Inst., Golden, Colo.
THE TRADE-OFF BETWEEN COLLECTOR AREA, STORAGE VOLUME, AND BUILDING CONSERVATION IN ANNUAL STORAGE SOLAR HEATING SYSTEMS
S. SILLMAN Mar. 1981 123 p refs
(Contract EG-77-C-01-4042)
(SERI/TR-721-907) Avail: NTIS HC A06/MF A01

A comprehensive study based on computer simulation of the performance of active solar heating systems with large storage tanks was made. The investigation focused on systems used to supply backup heat to passive solar and energy-conserving buildings as well as systems designed to meet standard heating loads. Results show that system performance increases linearly as storage volume is increased, up to the point where the storage tank is large enough to store all heat collected in summer. The optimal design for annual storage systems is discussed and a contrast with diurnal storage systems is made. It is suggested that the annual storage systems may be economically preferable to the diurnal systems. M.D.K.

N82-22670# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
THE TRADE-OFF BETWEEN COLLECTOR AREA, STORAGE VOLUME AND BUILDING CONSERVATION IN ANNUAL STORAGE SOLAR HEATING SYSTEMS
S. SILLMAN Apr. 1981 6 p refs Presented at AS/ISES Conf. and Exposition, Philadelphia, 26-30 May 1981
(Contract EG-77-C-01-4042)
(SERI/TR-721-907) Avail: NTIS HC A02/MF A01

A comprehensive computer simulation of the performance of active solar heating systems with long term hot water storage. Systems used to supply backup heat to passive solar and energy conserving buildings, as well as to meet standard heating and hot water loads were investigated. It is shown that system output increases linearly as storage volume increases, up to the point where the storage tank is large enough to store all heat collected in summer. This point, the point of unconstrained operation, is the likely economic optimum. Unlike diurnal storage systems, annual storage systems show only slightly diminished efficiency as system size increases. In contrast to diurnal systems, annual storage systems perform efficiently in meeting the load of a passive or energy efficient building. E.A.K.

N82-22676*# National Aeronautics and Space Administration, Washington, D. C.
THE FINAL PROCEEDINGS OF THE SOLAR POWER SATELLITE PROGRAM REVIEW
Jul. 1980 701 p refs Rev. held in Lincoln, Nebr., 22-25 Apr. 1980
(Contract DE-FG05-79ER-10116)
(NASA-TM-84183; NAS 1.15:84183; CONF-800491) Avail: NTIS HC A99/MF A01 CSCL 10A

The solar power satellite (SPS) concept defined as 'placing gigantic satellites in geosynchronous orbit to capture sunlight, changing the energy into an appropriate form for transmission to Earth, and introducing the energy into the electric power grid' is evaluated in terms of costs and benefits. The concept development and evaluation program is reviewed in four general areas: systems definition; environmental; societal; and comparative assessments. Specific factors addressed include: transportation, construction in space, methods of conversion of sunlight into energy, transmission to Earth, maintenance in orbit and decommissioning of satellites; environmental, political, and economic effects; and comparison of

SPS to other forms of power generation, both terrestrial and in space.

N82-22677*# National Aeronautics and Space Administration, Washington, D. C.
OVERVIEW OF SYSTEMS DEFINITION ACTIVITIES FOR SATELLTE POWER SYSTEMS
F. C. SCHWENK *In its* The Final Proc. of the Solar Power Satellite Program Rev. p 21-35 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Studies conducted by NASA of the Satellite Power System were reviewed and included considerations of the role of SPS as an energy system, space technology, ground systems, and environmental concerns. Various space transportation systems for placement of the SPS in an operational mode are discussed. T.M.

N82-22684*# General Electric Co., Schenectady, N. Y.
INTEGRATION OF SPS WITH UTILITY SYSTEM NETWORKS
B. M. KAUPANG *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 99-102 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

The integration of Satellite Power System (SPS) power in electric utility power systems is discussed. Specifically, the nature of the power output variations from the spacecraft to the rectenna, the operational characteristics of the rectenna power, and the impacts on the electric utility system from utilizing SPS power to serve part of the system load are treated. It is concluded that if RF beam control is an acceptable method for power control, and that the site distribution of SPS rectennas do not cause a very high local penetration (40 to 50%), SPS may be integrated into electric utility system with a few negative impacts. Increased regulating duty on the conventional generation, and a potential impact on system reliability for SPS penetration in excess of about 25% appear to be two areas of concern. M.G.

N82-22685*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPS COST METHODOLOGY AND SENSITIVITIES
R. O. PILAND *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 103-106 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

A total solar power satellite is defined and costs for such a program estimated. The program is assumed to consist of a number of phases from initial research to the completed production unit. Each phase represents an increasing commitment of resources as confidence in the ultimate success of the program grows. The total cost of the program through the first full-scale unit is estimated to be slightly over 100 billion dollars. The subsequent units are estimated to cost an average of 11.5 billion dollars per unit. M.G.

N82-22687*# European Space Technology Center, Noordwijk (Netherlands). Systems Engineering Dept.
CRITICAL TECHNOLOGY AREAS OF AN SPS DEVELOPMENT AND THE APPLICABILITY OF EUROPEAN TECHNOLOGY
D. KASSING and J. RUTH *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 109-112 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

Possible system development and implementation scenarios for the hypothetical European part of a cooperative Satellite Power System effort are discussed, and the technology and systems requirements which could be used as an initial guideline for further evaluation studies are characterized. Examples of advanced European space technologies are described including high power microwave amplifiers, antennas, advanced structures, multi-kilowatt solar arrays, attitude and orbit control systems, and electric propulsion. L.F.M.

N82-22694*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
REFERENCE SYSTEM CHARACTERIZATION AND COST OVERVIEW
R. O. PILAND *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 142-145 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

A brief description of the necessary elements of the Satellite Power System is presented. This reference system provides the basis for making preliminary cost estimates. L.F.M.

N82-22695*# Argonne National Lab., Ill.
SPS AND ALTERNATIVE TECHNOLOGIES COST AND PERFORMANCE EVALUATIONS
M. E. SAMSA *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 146-149 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Cost estimates for production of the electrical energy needed in the early twenty-first century are provided. Costs and performance of the Satellite Power System are compared with alternative methods of producing electrical energy. L.F.M.

N82-22702*# Bechtel National, Inc., San Francisco, Calif.
THE DESIGN OF LOW COST STRUCTURES FOR EXTENSIVE GROUND ARRAYS
H. A. FRANKLIN and R. S. LEONARD *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 185-188 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

The development of conceptual designs of solar array support structures and their foundations including considerations of the use of concrete, steel, aluminum, or timber are reported. Some cost trends were examined by varying selected parameters to determine optimum configurations. Detailed civil/structural design criteria were developed. Using these criteria, eight detailed designs for support structures and foundations were developed and cost estimates were made. As a result of the study wind was identified as the major loading experienced by these low height structures, whose arrays are likely to extend over large tracts of land. Proper wind load estimating is considered essential to developing realistic structural designs and achieving minimum cost support structures. Wind tunnel testing of a conceptual array field was undertaken and some of the resulting wind design criteria are presented. The SPS rectenna system designs may be less sensitive to wind load estimates, but consistent design criteria remain important. M.D.K.

N82-22715*# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.
PASSIVE SOLAR REFLECTOR SATELLITE REVISITED
C. POLK and J. C. DALY *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 231-233 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Passive light weight reflectors in space which direct the incident solar energy to a specified location on the Earth surface are proposed as an alternative system for the solar power satellite to overcome conversion losses and to avoid the need for photovoltaic cells. On Earth, either photovoltaic cells or a steam turbine alternator on a solar tower, or a similar conventional, relatively high efficiency cycle are used for electricity generation. The constraints which apply to the design of the optical system if a single satellite is placed in geostationary orbit are outlined. A single lens and a two lens system are discussed. J.M.S.

N82-22720*# Boeing Aerospace Co., Seattle, Wash.
PROTON DAMAGE ANNEALING KINETICS IN SILICON SOLAR CELLS
W. E. HORNE, I. ARIMURA, and A. C. DAY *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 254-257 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Proton damage annealing as a method for prolonging the life of solar power systems in space is discussed. Variables are

minimized and fundamental characteristics of proton damage annealing are considered. The usefulness of annealing for prolonging space missions is evaluated. A preliminary determination of optimum annealing conditions is made, and base data provided for more detailed research programs. J.D.

N82-22721*# Little (Arthur D.), Inc., Cambridge, Mass.
EVALUATION OF SOLAR CELL MATERIALS FOR A SOLAR POWER SATELLITE
P. E. GLASER, D. W. ALMGREN, and K. I. CSIGI *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 263-266 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

Alternative solar cell materials being considered for the solar power satellite are described and price, production, and availability projections through the year 2000 are presented. The chief materials considered are silicon and gallium arsenide. J.D.

N82-22745*# IBM Federal Systems Div., Westlake Village, Calif.
SATELLITE POWER SYSTEM OPERATIONS
F. L. PUGH and A. I. GORDON (Rockwell International, Seal Beach, Calif.) *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 368-371 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

A projection of the electrical energy demands over the next 30 to 50 years, coupled with reasonable assessments of known or developable energy sources, indicates that a shortage of electrical energy will occur about the turn of the century. Recognizing the criticality of such a shortage, the Department of Energy is currently evaluating alternative power generation concepts. One of these candidate concepts is the Satellite Power System. The power levels considered during the evaluation of the various satellite systems have ranged from 5 to 10 GW. It is apparent that, with this power level, both the satellite and the rectenna must be very large and encompass a large number of complex operational system activities. Major elements of the Satellite Power System (SPS) consist of a power satellite placed in a geosynchronous equatorial orbit, and a dedicated ground receiving station (GRS) located at a selected site within the continental United States. The nominal power output of the SPS is established at 5 gigawatts (5 million kilowatts) although, because of various system constraints or losses, it may actually produce between 4 and 5 gigawatts. N.W.

N82-22748*# Institute for Telecommunication Sciences, Boulder, Colo.
SUMMARY OF THE ELECTROMAGNETIC COMPATIBILITY EVALUATION OF THE PROPOSED SATELLITE POWER SYSTEM
E. L. MORRISON, JR., W. B. GRANT, and K. C. DAVIS (Battelle Memorial Inst., Richland, Wash.) *In* NASA, Washington The Final Proc. of the Solar Satellite Program Rev. p 414-418 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

The effects of the proposed solar power satellite (SPS) operations on electronic equipment and systems by fundamental, harmonic, and intermodulation component emissions from the orbital station; and the fundamental, harmonic, and structural intermodulation emissions from the rectenna site were evaluated. The coupling and affects interactions affecting a wide spectrum of electronic equipment are considered. The primary EMC tasking areas are each discussed separately. J.D.

N82-22749*# National Radio Astronomy Observatory, Socorro, N. Mex.
THE EFFECTS OF A SATELLITE POWER SYSTEM ON GROUND-BASED ASTRONOMY
A. R. THOMPSON *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 419-422 Jul. 1980 refs Sponsored in part by NSF
Avail: NTIS HC A99/MF A01 CSCL 10A

The effects of power transmission from the solar power satellite and of radiation from the ground based rectennas on radio astronomy, radar astronomy, and optical astronomy are discussed. Interference sources, acceptable signal and noise levels, and conflicting site requirements for observatories and rectennas are considered. J.D.

N82-22750*# Electromagnetic Compatibility Analysis Center, Annapolis, Md.
THE EMC OF SATELLITE POWER SYSTEMS AND DOD C-E SYSTEMS
J. H. ATKINSON and M. D. AASEN (ITT Research Inst., Annapolis, Md.) *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 424-427 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

The solar power satellite (SPS) technical parameters that are needed to accurately assess the electromagnetic compatibility (EMC) between SPS systems and DoD communications-electronics (C-E) systems are identified and assessed. The type of electromagnetic interactions that could degrade the performance of C-E systems are described and the major military installations in the southwestern portions of CONUS where specially sensitive C-E systems are being used for combat training and evaluation are identified. Classes of C-E systems that are generally in the vicinity of these military installations are considered. The Technical parameters that govern the degree of compatibility of the SPS with these C-E systems, and some technical requirements that are necessary to ensure short-term and long-term EMC are identified. J.D.

N82-22751*# Little (Arthur D.), Inc., Cambridge, Mass.
ENCOUNTERS BETWEEN SPS POWER BEAMS AND SATELLITES IN LOWER ORBITS
P. K. CHAPMAN *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 428-430 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Interference between the solar power satellite (SPS) power beam and other satellites in lower orbits is described. Measures which might be taken to reduce the frequency of beam/satellite encounters or to minimize the effects of the encounters are discussed. J.D.

N82-22775# Center for the Environment and Man, Inc., Hartford, Conn.
SOLAR POWERED DESICCANT AIR CONDITIONING SYSTEM Final Report
24 Jul. 1981 27 p refs
(Contract DE-AC02-76CS-52702; DE-AC02-77CS-34286; E(11-1)-2702; E(11-1)-4286)
(DE82-002656; DOE/CS-52702/T1; DOE/CS-34286) Avail: NTIS HC A03/MF A01

A solar-powered desiccant air conditioning system using silica gel was developed, and modifications to the existing unit and additional testing are proposed to demonstrate the feasibility of the unit. Conversion from a rotating bed to a fixed bed of silica gel is proposed. Some general plans for commercialization are briefly discussed. DOE

N82-22776# Porter (W. H.), Inc., Holland, Mich. Port-R-Span Div.
PASSIVE AND HYBRID SOLAR MANUFACTURED HOUSING AND BUILDINGS. PHASE 1: TECHNICAL PROPOSAL Final Report
K. F. OSIKA 1 Aug. 1981 49 p
(Contract DE-FC02-80CS-30388)
(DE82-002098; DOE/CS-30388/1) Avail: NTIS HC A03/MF A01

The design objective for manufacturing farrowing-nursery building for hog confinement which uses a minimal amount of winter heat and is relatively cool in summer is discussed. Savings are to be accomplished by using an air to air heat exchanger, a hot air collector, and a wood stove in place of backup bottle gas. Solar alternatives and design criteria are described. A thermal analysis was performed. DOE

N82-22777# Boeing Engineering and Construction, Seattle, Wash.
SECOND-GENERATION HELIOSTAT DEVELOPMENT FOR SOLAR-CENTRAL RECEIVERS Final Report
31 Mar. 1981 193 p Prepared for Sandia National Labs., Livermore, Calif.
(Contract DE-AC04-76DP-00789)
(DE82-001844; SAND-81-8175-VOL-1) Avail: NTIS HC A09/MF A01

A production heliostat for a 50 MW/sub e/ solar electric power plant is described. The detail design, along with trades, analyses, and testing in support of the design are presented. The collector subsystem's performance is assessed. Fabrication, checkout, and installation of two prototypes are described. DOE

N82-22778# Boeing Engineering and Construction, Seattle, Wash.
SECOND-GENERATION HELIOSTAT DEVELOPMENT FOR SOLAR-CENTRAL RECEIVERS, DETAIL DESIGN REPORT. VOLUME 1, APPENDIX Final Report
31 Mar. 1981 205 p Prepared for Sandia National Labs., Livermore, Calif.
(Contract DE-AC04-76DP-00789)
(DE82-001842; SAND-81-8175-VOL-1-APP-1) Avail: NTIS HC A10/MF A01

Details of design, analysis, and test of the heliostats are provided. The azimuth drive, bearing assembly, assembled gimbal, actuator drive assembly, reflectors, and control system are described. DOE

N82-22779# Boeing Engineering and Construction, Seattle, Wash.
SECOND-GENERATION HELIOSTAT DEVELOPMENT FOR SOLAR-CENTRAL RECEIVERS: VOLUME 1, DETAIL DESIGN REPORT. APPENDIX 2 Final Report, 24 Jul. - 24 Oct. 1980
WINSMITH (Ford Aerospace and Communications Corp.) et al. 31 Mar. 1981 392 p Prepared for Sandia National Labs., Livermore, Calif.
(Contract DE-AC04-76DP-00789)
(DE82-001843; SAND-81-8175-VOL-1-APP-2) Avail: NTIS HC A17/MF A01

Three different types of rotary drive and bearing assemblies are investigated. These drives are designed and sized to meet load and life requirements for an azimuth actuation system for a second generation heliostat program. A structural analysis of the actuator is included. Two other actuator types are briefly examined although they are sized to meet applicable load life specifications. The actuator design considered the most suitable for the applications consists of a small worm gear drive as the first reduction stage and of a differential planetary as the final reduction. DOE

N82-22780# Ford Motor Co., Deerborn, Mich.
SECOND-GENERATION HELIOSTAT DEVELOPMENT FOR SOLAR-CENTRAL CENTRAL RECEIVERS. DETAIL DESIGN REPORT: VOLUME 2, APPENDICES I, J Final Report
31 Mar. 1981 499 p Prepared for Boeing Engineering and Construction Prepared in cooperation with Ford Aerospace and Communications Corp.
(Contract DE-AC04-76DP-00789)
(DE82-001837; SAND-81-8175-VOL-2-APP-I AND J) Avail: NTIS HC A21/MF A01

A heliostat manufacturing study consisting of evaluations of variable cost and investment costs, program engineering, training, preactivation and launching, savings opportunities, and selling price is presented. Descriptions of the facilities and manufacturing plan are included. General support departments and systems and other backup data are included as well as detailed cost and process description data for the heliostat facet assembly. DOE

N82-22784# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.
SPACE AND ENERGY: GLOBAL VIEWPOINT
D. E. KOELLE 1981 13 p refs Presented at 1st Intern. Aerospace Symp., Le Bourget, 2-3 Jun. 1981; sponsored by AIAA/Aerosalon
(MBB-UR-489-81-O) Avail: NTIS HC A02/MF A01

The potential contributions from space technology to solving the future world energy problem are addressed. The basic problem is created by the depletion of the fossile fuels in the next century. The replacement of oil, gas and coal is only feasible by nuclear power and solar energy. In the first case space technology can contribute to making the terrestrial storage of radioactive waste much less dangerous and more acceptable by expediting the highly radioactive components (only 3%) into space. In the case of solar energy space technology can contribute large solar power stations in space, providing energy via microwaves to special rectenna sites. J.M.S.

N82-22785# Kloeckner und Co. Waermetechnik, Hechingen (West Germany).
DEVELOPMENT OF CONTROL SYSTEMS FOR SOLAR WATER AND SOLAR SPACE HEATING EQUIPMENT. CHOICE OF HEAT CONDUCTING FLUID. TESTING Final Report, Apr. 1980
H. MEYER Bonn Bundesministerium fuer Forschung und Technologie Nov. 1981 81 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-185; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 17,20

Flat plate collector systems suitable for hot water supply, swimming pool heating, and auxiliary space heating were developed. A control and ready made packaged pipe assembly, adapted to synthetic fluid, was developed. A heat transfer fluid was selected, pumps, safety devices, armatures and seals were tested for their long term performance. External heat exchangers for simple and cascade arrangement of the hot water tanks were tested. It is found that the channel design of a roll bonded absorber has only limited effect on collector performance if the channel width approximates the space between the plates. Systems already installed work satisfactorily. Author (ESA)

N82-22786# Fondazione Ugo Bordoni, Rome (Italy).
SOLAR RADIATION CHARACTERISTICS AND PREDICTION METHODS [CARATTERISTICHE METODI DI PREVISIONE DELLA RADIAZIONE SOLARE]
F. BARBALISCIA Jun. 1981 52 p refs In ITALIAN Sponsored by Ente Nazionale per l'Energia Eletricca
(FUB-7-1981) Avail: NTIS HC A04/MF A01

Mathematical and statistical studies were carried out in order to provide a ground level solar radiation estimation, starting from meteorological data for given locations. Available insolation and meteorological historical series of Italian localities were used. Solar energy averaged over 24 hr periods is predictable with acceptable

accuracy and, in certain cases, hourly energy distribution data can be obtained with an accuracy level sufficient for passive solar energy system design. For large active solar energy systems, further studies and detailed measurements are required. Author (ESA)

N82-22788# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Kernphysik.
TEST STATION FOR SOLAR COLLECTORS IN BRAZIL Final Report, Feb. 1981
J. ANHALT, K. MASSMEYER, and H. J. STEIN Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 77 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie Original contains color illustrations
(BMFT-FB-T-81-224; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15,26

A test facility for solar collector systems, operating in the temperature range above 100 C, was developed. Research and development programs for the utilization of solar energy are discussed. Conversion efficiency and heat loss measurements relative to experimental collectors under operational climatic conditions are presented. Meteorological data acquisition and measurement data processing are explained. Availability of the facility for further studies is summarized, including methodology for choice and construction of solar energy system components.
Author (ESA)

N82-23149# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
A POINT FOCUSING COLLECTOR FOR AN INTEGRATED WATER/POWER COMPLEX
H. ZEWEN, G. SCHMIDT, and S. MOUSTAFA *In its* Res. and Develop. at MBB. Tech. and Sci. Publ., 1981 17 p 1981 refs Presented at 20th Intern. Conf. on Cooperation Mediterraneenne pour l'Energie Solaire, Rabat, Morocco, 23-27 Nov. 1981
(MBB-UR-579-81-OE) Avail: NTIS HC A09/MF A01

A point focusing parabolic dish was developed in order to deliver process heat and as a solar collector for small solar thermal power stations. The utilization potential of the point focusing parabolic dish was identified and its main design parameters are summarized. The utilization of the collector as primary energy source in a food/water/power complex was tested. In its present configuration, the system is capable of delivering process heat for the temperature range from 150 to 500 C. This point focusing parabolic dish is identified as the most promising solar collector for small solar thermal power stations. Fifty-six dishes were assembled in a 100 kW (electric)/500 kW (thermal) food/water/power complex, which is in operation in the Kuwait desert. The dominating factors for cost reduction are discussed.
Author (ESA)

N82-23353*# Societe Europeenne de Propulsion, Vernon (France).
DESIGN ASPECTS OF A SOLAR ARRAY DRIVE FOR SPOT, WITH A HIGH PLATFORM STABILITY OBJECTIVE
J. CABILLIC, J. P. FOURNIER, P. ANSTETT, M. SOULIAC, and G. THOMIN (CNES) *In* NASA. Kennedy Space Center The 16th Aerospace Mech. Symp. p 143-157 May 1981 Prepared in cooperation with MATRA
Avail: NTIS HC A15/MF A01 CSCL 13I

A solar array drive mechanism (MEGS) for the SPOT platform, which is a prototype of a multimission platform, is described. High-resolution cameras and other optical instruments are carried by the platform, requiring excellent platform stability in order to obtain high-quality pictures. Therefore, a severe requirement for the MEGS is the low level of disturbing torques it may generate considering the 0.6 times 10 to the minus 3 power deg/sec stability required. The mechanical design aspects aiming at reducing the mean friction torque, and therefore its fluctuations, are described as well as the method of compensation of the motor imperfections. It was concluded, however, that this is not sufficient to reach the stability requirement. M.D.K.

N82-23359*# British Aerospace Dynamics Group, Bristol (England).
A DEPLOYMENT MECHANISM FOR THE DOUBLE ROLL-OUT FLEXIBLE SOLAR ARRAY ON THE SPACE TELESCOPE
T. R. CAWSEY *In* NASA. Kennedy Space Center The 16th Aerospace Mech. Symp. p 223-233 May 1982 refs
Avail: NTIS HC A15/MF A01 CSCL 13I

A roll-out flexible array which provides more than 4 kW of power for the space telescope was developed. The Array is configured as two wings. The deployment mechanism for each wing is based on flight-proven FRUSA design. Modifications have been incorporated to accommodate an increase in size and mission requirements. The assembly and operation of the deployment mechanism are described together with environmental and functional tests results. Author

N82-23368# Mid-American Solar Energy Complex, Minneapolis, Minn.
AUDIO-VISUAL SUMMARY OF PASSIVE SOLAR COMMERCIAL BUILDINGS DEVELOPMENT IN THE MASEC REGION
Aug. 1981 10 p
(Contract DE-AC02-79CS-30151)
(DE82-003136; MASEC-R-81-039; P-104-2) Avail: NTIS HC A02/MF A01

An audio-visual presentation documenting the use of passive solar technologies in commercial buildings within the Mid-American Region is summarized. The presentation consists of 50 35-millimeter slides with accompanying narrative. The slide show gives a brief introduction to the use of direct gain, indirect gain, and isolated gain systems with commercial examples of each.
DOE

N82-23650*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE LOW-COST SOLAR ARRAY WAFERING WORKSHOP
A. D. MORRISON 1 Feb. 1982 300 p refs Workshop held in Phoenix, Ariz., 8-10 Jun. 1981
(Contract NAS7-100; DE-AI01-76ET-20356)
(NASA-CR-168847; JPL-PUB-82-9; DOE/JPL-1012-66; NAS 1.26:168847) Avail: NTIS HC A13/MF A01 CSCL 10A

The technology and economics of silicon ingot wafering for low cost solar arrays were discussed. Fixed and free abrasive sawing wire, ID, and multiblade sawing, materials, mechanisms, characterization, and innovative concepts were considered.

N82-23651*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LSA PROJECT PERSPECTIVE OF WAFERING TECHNOLOGY
K. M. KOLIWAD *In its* Proc. of the Low-Cost Solar Array Wafering Workshop p 3-11 1 Feb. 1982
Avail: NTIS HC A13/MF A01 CSCL 10A

The economics and techniques for eliminating wafering as a part of ingot technology in the production of silicon sheets for photovoltaic applications are considered. Technical progress in both ingot and non-ingot technologies for the low cost solar array project is described in the context of process economics. The critical areas of research in wafering are delineated and their payoff potential discussed. J.D.

N82-23652*# Pennsylvania Univ., Philadelphia.
COMPARISON OF VARIOUS SILICON SAWING METHODS
M. WOLF *In* JPL Proc. of the Low-Cost Solar Array Wafering Workshop p 13-23 1 Feb. 1982 refs
Avail: NTIS HC A13/MF A01 CSCL 10A

The technology and economics of four methods of wafering silicon boules of large cross section are described. Slurry sawing using either blades or wires, and fixed abrasive sawing using the ID saw or by the FAST method, having the abrasive attached to wires which are arranged in a blade pack, are considered. The

technical performance of each method is evaluated and cost/price estimates are summarized. J.D.

N82-23653*# ARCO Solar, Inc., Chatsworth, Calif.
ARCO SOLAR, INCORPORATED: THE INDUSTRIAL POINT OF VIEW
J. W. YERKES *In* JPL Proc. of the Low-Cost Solar Array Wafering Workshop p 25-28 1 Feb. 1982
Avail: NTIS HC A13/MF A01 CSCL 10A

The status of technological developments in silicon wafer production is summarized. Wafer growing and casting/sawing methods are considered. aba J.D.

N82-23654*# Applied Solar Energy Corp., City of Industry, Calif.
SOME DISCONNECTED SPECULATIONS ON SLICING SILICON
P. A. ILES *In* JPL Proc. of the Low-Cost Solar Array Wafering Workshop p 29-32 1 Feb. 1982
Avail: NTIS HC A13/MF A01 CSCL 10A

The basic principles for qualifying silicon wafering methods are summarized, and unconventional methods of wafering was discussed. Methods of cleaving analogous to diamond cutting, geological processes employing the expansion of freezing water, and karate chops are touched upon. J.D.

N82-23665*# Applied Solar Energy Corp., City of Industry, Calif.
FIELD EXPERIENCE WITH VARIOUS SLICING METHODS
H. I. YOO *In* JPL Proc. of the Low-Cost Solar Array Wafering Workshop p 179-185 1 Feb. 1982 Sponsored in part by DOE
Avail: NTIS HC A13/MF A01 CSCL 10A

Wafer slicing using internal diameter (ID) saw, multiblade slurry (MBS) saw and multiwire slurry (MWS) saw techniques were evaluated. Wafer parameters such as bow, taper, and roughness which may not be important factors for solar cell fabrication, were considerably better for ID saw than those of the MBS and MWS saw. Analysis of add-on slicing cost indicated that machine productivity seems to be a major limiting factor for ID saw, while expendible material costs are a major factor for both MBS and MWS saw. Slicing experience indicated that the most important factors controling final wafer cost are: (1) silicon cost (wafer thickness + kerf loss); (2) add-on slicing cost, and (3) mechanical yield. There is a very strong interaction between these parameters, suggesting a necessity of optimization of these parameters. A.R.H.

N82-23666*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOME TRADEOFFS IN INGOT SHAPING AND PRICE OF SOLAR PHOTOVOLTAIC MODULES
T. DAUD *In its* Proc. of the Low-Cost Solar Array Wafering Workshop p 187-196 1 Feb. 1982 refs
Avail: NTIS HC A13/MF A01 CSCL 10A

Growth of round ingots is cost-effective for sheets but leaves unused space when round cells are packed into a module. This reduces the packing efficiency, which approaches 95% for square cells, to about 78% and reduces the conversion efficiency of the module by the same ratio. Shaping these ingots into squares with regrowth of cut silicon improves the packing factor, but increases growth cost. The cost impact on solar cell modules was determined by considering shaping ingots in stages from full round to complete square. The sequence of module production with relevant price allocation guidelines is outlined. The severe penalties in add-on price due to increasing slice thickness and kerf are presented. Trade-offs between advantages of recycling silicon and shaping costs are developed for different slicing scenarios. It is shown that shaping results in cost saving of up to 21% for a 15 cm dia. ingot. A.R.H.

N82-23667*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SENSITIVITY ANALYSIS OF ADD-ON PRICE ESTIMATE FOR SELECT SILICON WAFERING TECHNOLOGIES
A. R. MOKASHI *In its* Proc. of the Low-Cost Solar Array Wafering Workshop p 197-209 1 Feb. 1982 refs
Avail: NTIS HC A13/MF A01 CSCL 10A

The cost of producing wafers from silicon ingots is a major component of the add-on price of silicon sheet. Economic analyses of the add-on price estimates and their sensitivity internal-diameter (ID) sawing, multiblade slurry (MBS) sawing and fixed-abrasive slicing technique (FAST) are presented. Interim price estimation guidelines (IPEG) are used for estimating a process add-on price. Sensitivity analysis of price is performed with respect to cost parameters such as equipment, space, direct labor, materials (blade life) and utilities, and the production parameters such as slicing rate, slices per centimeter and process yield, using a computer program specifically developed to do sensitivity analysis with IPEG. The results aid in identifying the important cost parameters and assist in deciding the direction of technology development efforts. A.R.H.

N82-23668*# Semix, Inc., Gaithersburg, Md.
WAFERING ECONOMIES FOR INDUSTRIALIZATION FROM A WAFER MANUFACTURER'S VIEWPOINT
T. P. ROSENFIELD and F. P. FUERST *In* JPL Proc. of the Low-Cost Solar Array Wafering Workshop p 211-229 1 Feb. 1982 refs
Avail: NTIS HC A13/MF A01 CSCL 10A

The key technical limitations which inhibit the lowering of value-added costs for state-of-the-art wafering techniques are assessed. From the best experimental results to date, a projection was made to identify those parts of each system which need to be developed in order to meet or improve upon the value-added cost reduction necessary for $0.70/Wp photovoltaics modules. A.R.H.

N82-23669*# Crystal Systems, Inc., Salem, Mass.
OVERVIEW OF A NEW SLICING METHOD: FIXED ABRASIVE SLICING TECHNIQUE (FAST)
F. SCHMID, M. B. SMITH, and C. P. KHATTAK *In* JPL Proc. of the Low-Cost Solar Array Wafering Workshop p 233-241 1 Feb. 1982 refs Sponsored in part by DOE
Avail: NTIS HC A13/MF A01 CSCL 10A

The fixed abrasive slicing technique (FAST) was developed to slice silicon ingots more effectively. It was demonstrated that 25 wafers/cm can be sliced from 10 cm diameter and 19 wafers/cm from 15 cm diameter ingots. This was achieved with a combination of machine development and wire-blade development programs. Correlation was established between cutting effectiveness and high surface speeds. A high speed slicer was designed and fabricated for FAST slicing. Wirepack life of slicing three 10 cm diameter ingots was established. Electroforming techniques were developed to control widths and prolong life of wire-blades. Economic analysis indicates that the projected add-on price of FAST slicing is compatible with the DOE price allocation to meet the 1986 cost goals. M.G.

N82-23672*# Silicon Technology Corp., Oakland, N. J.
ID SLICING AND THE AUTOMATED FACTORY
T. LEWANDOWSKI *In* JPL Proc. of the Low-Cost Solar Array Wafering Workshop p 253-258 1 Feb. 1982
Avail: NTIS HC A13/MF A01 CSCL 10A

The automation of the slicing system utilizing internal-diameter saws for the production of the silicon wafers used in solar arrays is discussed. It is argued that saw productivity can be increased by reducing silicon waste, decreasing usage of consumables, keeping the saw slicing, and increasing the cutting speed. Several machine enhancements utilizing automatic control are discussed. The need for record keeping to anticipate maintenance operations is noted, and a digital serial communication interface with the microprocessor-based saws is recommended. Distributed control

of the manufacturing process is discussed in detail, and is recommended as a method for increasing productivity. R.J.F.

N82-23681# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SOLAR ENERGY LEGAL BIBLIOGRAPHY SECOND UPDATE
S. WEINER May 1981 94 p
(Contract EG-77-C-01-4042)
(SERI/TR-744-876) Avail: NTIS HC A05/MF A01

Approximately 100 publications were abstracted for their legal and policy content with respect to solar energy. Emphasis was on legal barriers and incentives to solar energy development. Subject arrangement covers 24 categories. An author index is included. N.W.

N82-23741# Black and Veatch Consulting Engineers, Kansas City, Mo.
SOLAR COGENERATION FACILITY: CIMARRON RIVER STATION, CENTRAL TELEPHONE AND UTILITIES-WESTERN POWER. EXECUTIVE SUMMARY
7 Aug. 1981 38 p 3 Vol.
(Contract DE-AC03-81SF-11439)
(DE82-001898; DOE/SF-11439/1-VOL-1) Avail: NTIS HC A03/MF A01

A brief overview of the conceptual design of a solar central receiver system integrated with an existing cogeneration facility is provided. A synopsis of the performance, an economic evaluation, and an assessment of the concept from the site owner's perspective are given. DOE

N82-23742# Black and Veatch Consulting Engineers, Kansas City, Mo.
SOLAR COGENERATION FACILITY: CIMARRON RIVER STATION, CENTRAL TELEPHONE AND UTILITIES-WESTERN POWER Final Report
7 Aug. 1981 24 p refs 3 Vol.
(Contract DE-AC03-81SF-11439)
(DE82-001921; DOE/SF-11439/1-VOL-2) Avail: NTIS HC A02/MF A01

A site-specific conceptual design and evaluation of a solar central receiver system integrated with an existing cogeneration facility are described. The system generates electricity and delivers a portion of that electricity and process steam to a natural gas processing plant. Early in the project, tradeoff studies were performed to establish key system characteristics. As a result of these studies the use of energy storage was eliminated, the size of the solar facility was established at 37.13 MW (sub t), and other site-specific features were selected. The conceptual design addressed critical components and system interfaces. The result is a hybrid solar/fossil central receiver facility which utilizes a collector system of Department of Energy second generation heliostats. DOE

N82-23743# Black and Veatch Consulting Engineers, Kansas City, Mo.
SOLAR COGENERATION FACILITY: CIMARRON RIVER STATION, CENTRAL TELEPHONE AND UTILITIES-WESTERN POWER, APPENDICES
7 Aug. 1981 24 p refs
(Contract DE-AC03-81SF-11439)
(DE82-001852; DOE/SF-11439/1-VOL-3) Avail: NTIS HC A10/MF A01

The characteristics, design requirements, and environmental requirements for the solar cogeneration facility are specified, including conceptual design, performance, and economic data for the solar facility and certain design data for the existing facility. A detailed breakdown of the construction cost estimate is provided. DOE

N82-23745# JRB Associates, McLean, Va.
DESIGN HANDBOOK FOR PHOTOVOLTAIC-POWER SYSTEMS: SIMPLIFIED METHODS FOR UTILITY INTERCONNECTED SYSTEMS
Y. P. GUPTA and S. K. YOUNG Oct. 1981 233 p refs
(Contract DE-AC04-76DP-00789)
(DE82-003909; SAND-80-7147-VOL-2) Avail: NTIS HC A11/MF A01

Two nomograms are presented, one for computing the economic feasibility of a photovoltaic system, and the other for sizing the preliminary PB array area. Worksheets are provided for computing PV system economic feasibility, preliminary collector area estimates, electerical loads, system output and costs, present worth analysis, solar fraction, array sizing analysis, and thermal analysis for combined PV/thermal systems. Climate statistics and insolation, shading factors, daytime solar fraction coefficients and present worth factors are tabulated. DOE

N82-23746# Sandia Labs., Albuquerque, N. Mex.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 4: FOR NEWMAN POWER STATION, EL PASO, TEXAS
Oct. 1981 16 p refs Prepared in cooperation with Boeing Computer Services Co., Seattle
(Contract DE-AC04-76DP-00789)
(DE82-002681; SAND-81-7086/4) Avail: NTIS HC A02/MF A01

Performance data are given for a photovoltaic power supply at a Texas utility for the month of August 1981. Included are: total and daily electrical energy production; total monthly and daily incident solar energy; monthly and daily efficiency; graphs of energy production as a function of power level, voltage, cell temperature, and hour of the day; system availability; heating and cooling degree days, average monthly insolation, ambient temperature and wind speed, and average insolation, ambient temperature, cell temperature, and wind speed graphed versus hour of the day. DOE

N82-23747# Sandia Labs., Albuquerque, N. Mex.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL EXECUTIVE SUMMARY. VOLUME 3: FOR LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NEW MEXICO
Oct. 1981 7 p refs
(Contract DE-AC04-76DP-00789)
(DE82-003082; SAND-81-7099/3) Avail: NTIS HC A02/MF A01

For the month of August 1981, daily and monthly electricity production and daily, monthly insolation and monthly array efficiency are given. These data are given for a 100 kW photovoltaic flat panel facility at a New Mexico shopping center. DOE

N82-23751# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
LOW COST SOLAR ENERGY COLLECTION FOR COOLING APPLICATIONS
W. G. WILHELM Jun. 1981 19 p refs
(Contract DE-AC02-76CH-00016)
(DE82-003255; BNL-51408) Avail: NTIS HC A02/MF A01

Solar energy collector designs utilizing thin-film polymeric materials in the absorber and glazing are investigated. The main objective is dramatic cost reduction consistent with acceptable performance and life. These collectors now appear capable of high temperature applications including desiccant and absorption cooling (1500 to 2000 F). The performance and economics of the thin-film collector are compared with those of conventional flat-plate designs in cooling applications. DOE

N82-23752# Sandia Labs., Albuquerque, N. Mex.
ANALYSIS OF 70-TUBE PILOT-PLANT SOLAR-RECEIVER-PANEL TEST DATA
L. N. KMETYK and R. K. BYERS Aug. 1981 65 p refs
(Contract DE-AC04-76DP-00789)
(DE82-001728; SAND-81-1220) Avail: NTIS HC A04/MF A01

An analytic model for a solar receiver boiler panel was developed, using the RELAP4 nuclear plant systems thermal hydraulic computer code. Results are compared to other computer calculations and experimental data. The test panels were prototypes of panels to be used in the Barstow 10 MWe solar electric pilot power plant central receiver. Steady state operating conditions for a given incident heat flux were calculated from a zero power cold water startup. The effects of incident flux axial profile shape and of lateral flux gradients were studied, as was the dynamic response of the model to flux and flow transients. The nodalization detail required for accurate simulation was also determined. DOE

N82-23755# Sandia Labs., Albuquerque, N. Mex.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE: EXECUTIVE SUMMARY. VOLUME 1: LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NEW MEXICO
Sep. 1981 16 p refs Prepared in cooperation with Boeing Computer Services Co., Seattle
(Contract DE-AC04-76DP-00789)
(DE82-001710; SAND-81-7099/1) Avail: NTIS HC A02/MF A01

For the months of April through June 1981, performance data are given for a 100 kW photovoltaic flat panel grid connected facility at a New Mexico shopping center. For each month, the monthly total electrical energy production and insolation, and array efficiency are given and the daily energy produced and insolation are graphed. DOE

N82-23756# Sandia Labs., Albuquerque, N. Mex.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE: EXECUTIVE SUMMARY. VOLUME 2: NEWMAN POWER STATION, EL PASO, TEXAS
Sep. 1981 23 p Prepared in cooperation with Boeing Computer Services Co., Seattle
(Contract DE-AC04-76DP-00789)
(DE82-001711; SAND-81-7100/2) Avail: NTIS HC A02/MF A01

For the months of February through July 1981, except June, performance data are given for a 20 kWg photovoltaic flat panel power system for an uninterruptable power supply load in Texas. For each month, the monthly total electrical energy production and insolation and array efficiency are given and the daily energy production and insolation are graphed. DOE

N82-23757# Sandia Labs., Albuquerque, N. Mex.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE: EXECUTIVE SUMMARY. VOLUME FOR BEVERLY HIGH SCHOOL, BEVERLY, MASSACHUSETTS
Sep. 1981 10 p refs Prepared in cooperation with Boeing Computer Services Co., Seattle
(Contract DE-AC04-76DP-00789)
(DE82-001726; SAND-81-7102/1) Avail: NTIS HC A02/MF A01

For the month of July 1981, performance data are given for a grid connected 100 kW photovoltaic flat panel power system at a high school in Massachusetts. The total electrical energy produced and solar energy incident on the solar cells, array and system efficiency, capacity factor, and insolation are given for the month and the daily energy production and incident solar energy are graphed. DOE

N82-23758# Sandia Labs., Albuquerque, N. Mex.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE: EXECUTIVE SUMMARY. VOLUME 1 FOR MT. LAGUNA RADAR STATION, MT. LAGUNA, CALIFORNIA
Sep. 1981 28 p refs Prepared in cooperation with Boeing Computer Services Co., Seattle
(Contract DE-AC04-76DP-00789)
(DE82-001727; SAND-81-7104/1) Avail: NTIS HC A03/MF A01

For the months of January through July 1981, performance data are given for a photovoltaic array with two different types of photovoltaic modules, a paralleling, and monitoring panel, a power conversion subsystem, and a data acquisition system. For each month, the monthly total electrical energy production and insolation, array efficiency, system efficiency, and capacity factor are given and the daily energy production and insolation are graphed. DOE

N82-23765# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Solar Energy Systems Dept.
FORT HOOD SOLAR COGENERATION FACILITY CONCEPTUAL DESIGN STUDY. VOLUME 1: TECHNICAL REPORT Final Technical Report
Aug. 1981 397 p 2 Vol.
(Contract DE-AC03-81SF-11495)
(DE82-000836; DOE/SF-11495/T1-VOL-1; MDC-G-9716-VOL-1)
Avail: NTIS HC A17/MF A01

A solar heated heat transfer salt provides heat to a steam generation and provides space heating and air conditioning and hot water for the complex. The site and its climate are described briefly. Candidate site specific system configurations, technology assessments, system sizing, and the results of numerous trade studies leading toward the selection of the preferred system configuration are presented. A system level conceptual design of the cogeneration facility is presented, and the cconceptual design of the subsystems (heliostats, receiver, tower, energy transport and storage, fossil energy subsystem, electric power generation subsystem, control, space conditioning and domestic hot water subsystem) are described. Results of the economic analysis of the cogeneration facility are presented, including a description of analysis methods used, assumptions and rationale, simulation models used, a brief summary of capital and operations and maintenance costs, fuel savings, results of the economic evaluations and an economic scenario for future applications. T.M.

N82-23766# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Solar Energy Program Dept.
FORT HOOD SOLAR COGENERATION FACILITY CONCEPTUAL DESIGN STUDY. VOLUME 2: SYSTEM SPECIFICATION Final Technical Report
Aug. 1981 324 p refs 2 Vol.
(Contract DE-AC03-81SF-11495)
(DE82-001579; DOE/SF-11495/T1-VOL-2; MDC-G-9716-VOL-2)
Avail: NTIS HC A14/MF A01

The characteristics and design and the environmental requirements for a solar cogeneration facility at a Texas military facility are specified. In addition, the conceptual design and performance characteristics, cost and economic data and other information for the cogeneration facility designed to meet the requirements are summarized. DOE

N82-23767# General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
TEXASGULF SOLAR COGENERATION PROGRAM, VOLUME 1 Final Report, 1 Sep. 1980 - 1 Jun. 1981
D. J. BISANTZ, K. D. BISHOP (Texasgulf Chemicals Co.), W. HERRINGTON (Texasgulf Chemicals Co.), H. E. JONES, P. KARNOSKI (Brown and Root Development, Inc.), and S. I. SCHAFITZ Jun. 1981 158 p 2 Vol.
(Contract DE-AC03-80SF-11437)
(DE82-001900; DOE/SF-11437/T4-VOL-1) Avail: NTIS HC A05/MF A01

A site specific conceptual design was generated for a near term Solar Cogeneration Facility based upon solar central receiver technology. Various system trade studies were conducted to select an optimum system configuration for the selected industrial site, as well as a configuration with the potential for wide industrial applicability. System performance and cost estimates were prepared and utilized to assess the economics of the near term facility, as well as a similar commercial size facility. A development plan was then generated with the objective of efficiency achieving facility operation by 1985. The selected industrial site is Texasgulf's Comanche Creek Sulfur Mine near Fort Stockton, Texas. The Solar Cogeneration Facility will operate 24 hours per day, 365 day per year in the hybrid (solar and fossil) or fossil only modes of operation. High reliability, a definite requirement for Frasch process sulfur mining as well as other industrial process heat operations, is incorporated into the design. DOE

N82-23768# General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
TEXASGULF SOLAR COGENERATION PROGRAM. VOLUME 2: APPENDICES Final Report
D. J. BISANTZ 1 Jun. 1981 96 p refs
(Contract DE-AC03-80SF-11437)
(DE82-001848; DOE/SF-11437/T4-VOL-2) Avail: NTIS HC A05/MF A01

The subsystem characteristics and required operating modes for a solar cogeneration facility to be located at a Texas sulfur mine are specified. Cost estimates for six storage system concepts are summarized, and the costs of storage media are tabulated. Data for use in estimating the cost of storage tanks, and heat exchangers and a methodology for estimating indirect costs are given. The cartesian coordinates of each of the 588 heliostats in the collector field are given. A water steam receiver loss computer program is listed. DOE

N82-23772# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL EXECUTIVE SUMMARY. VOLUME 2: FOR LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NEW MEXICO
Oct. 1981 7 p refs Prepared for Sandia National Labs. 3 Vol.
(Contract DE-AC04-76DP-00789)
(DE81-003081; SAND-81-7099/2-VOL-2) Avail: NTIS HC A02/MF A01

For the month of July 1981, the daily and monthly insolation, daily and monthly electricity production, and monthly array efficiency are given for a 100 kW photovoltaic flat panel. The facility was located at a New Mexico shopping center. (LEW) DOE

N82-23773# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL EXECUTIVE SUMMARY. VOLUME 3: FOR NEWMAN POWER STATION, EL PASO, TEXAS
Oct. 1981 7 p refs Prepared for Sandia National Labs. 3 Vol.
(Contract DE-AC04-76DP-00789)
(DE82-003088; SAND-81-7100/3-VOL-3) Avail: NTIS HC A02/MF A01

For the month of August 1981, the daily and monthly insolation, daily and monthly energy production, and monthly array efficiency are given for a 20 kW photovoltaic flat panel power system. The panel system is for an uninterruptable power supply load at a Texas utility. (LEW) DOE

N82-23800# Sandia Labs., Livermore, Calif.
CHARACTERIZATION OF THE CORROSION ENVIRONMENT OF THE DESERT NEAR BARTSTOW, CALIFORNIA
D. A. HUGHES Sep. 1981 30 p refs
(Contract DE-AC04-76DP-00789)
(DE82-003876; SAND-81-8252) Avail: NTIS HC A03/MF A01

The corrosion characteristics of the desert atmosphere environment near Barstow, CA were evaluated for the solar pilot plant receiver panel. Potential degradation mechanisms considered were not corrosion from molten salts and stress corrosion cracking in aqueous environments. The possibility of degradation from these mechanisms depends on the chemical composition of airborne particulates, aerosols, and gases. These particulates and aerosol were collected near the pilot plant site and analyzed for water and acid soluble Na(+), Mg(++), Li(+), S(--), SO4(--), and Cl(-). Comparison and evaluation of the quantities of these ions present with those necessary for corrosion indicate that external corrosion of the receiver due to the desert atmosphere environment is unlikely. DOE

N82-24394# National Bureau of Standards, Washington, D.C. National Engineering Lab.
SOLAR INDUSTRIAL PROCESS HEAT SYSTEMS: AN ASSESSMENT OF STANDARDS FOR MATERIALS AND COMPONENTS
W. J. ROSSITER and W. E. SHIPP Sep. 1981 98 p refs Sponsored in part by DOE
(PB82-133703; NBSIR-81-2381) Avail: NTIS HC A05/MF A01 CSCL 13A

A study was conducted to obtain information on the performance of materials and components in operational solar industrial process heat (PH) systems, and to provide recommendations for the development of standards including evaluative test procedures for materials and components. An assessment of the needs for standards for evaluating the long-term performance of materials and components of IPH systems was made. The assessment was based on the availability of existing standards, and information obtained from a field survey of operational systems, the literature, and discussions with individuals in the industry. Field inspections of 10 operational IPH systems were performed. Author (GRA)

N82-24640* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOLAR ENGINE Patent
R. N. JENSEN, inventor (to NASA) 27 Apr. 1981 6 p Filed 22 Jun. 1979 Supersedes N79-29608 (17 - 20, p 2692)
(NASA-CASE-LAR-12148-1; US-PATENT-4,326,381; US-PATENT-APPL-SN-051275; US-PATENT-CLASS-60-641.14; US-PATENT-CLASS-60-516) Avail: US Patent and Trademark Office CSCL 10B

A solar engine is disclosed in which a fluid, which is first heated and then cooled, forces a piston outward as the fluid is heated, and then draws the piston inward as the fluid is cooled. The piston is connected to a shaft and produces work as it moves outward and inward. A displacer plate moves between an absorber plate and a cooling plate to form an air space between the displacer and one or the other of these two plates for heating and cooling the fluid. The displacer plate is moved from one plate to the other by the displacer push ring as the piston nears the midpoint of its travel on the outward stroke and again on the inward stroke. Official Gazette of the US Patent and Trademark Office

N82-24646*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SUBSYSTEMS DESIGN AND COMPONENT DEVELOPMENT FOR THE PARABOLIC DISH MODULE FOR SOLAR THERMAL POWER SYSTEMS Annual Technical Report
C. K. STEIN 15 Mar. 1982 30 p Prepared in cooperation with NASA. Lewis Research Center
(Contract NAS7-10; DE-AT04-81AL-16228)
(NASA-CR-168941; DOE/JPL-1060-51; JPL-PUB-82-22; NAS 1.26:168941) Avail: NTIS HC A03/MF A01 CSCL 10A

Solar thermal power systems parabolic dish activities are summarized. Subsystem designs of concentrators, receivers, engines, power converters, and thermal transport are discussed. Analyses, test results, field tests, small community system development and the parabolic dish test site are also included.
Author

N82-24666# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
AN OVERVIEW OF THE SERI SOLAR ENERGY STORAGE PROGRAM
C. E. WYMAN *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 47-49 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

Thermal energy storage concepts and thermal energy transport by sensible and latent heat media are studied. Systems analyses are performed of thermal energy storage for solar thermal applications, and surveys and assessments are used to coordinate thermal energy storage activities for solar applications, particularly in building heating and cooling.
S.L.

N82-24669# Stearns-Roger Corp., Denver, Colo.
COST AND PERFORMANCE OF THERMAL STORAGE CONCEPTS IN SOLAR THERMAL SYSTEMS
A. W. MCKENZIE *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 58-59 Mar. 1981
Avail: NTIS HC A16/MF A01

Studies to provide consistently calculated cost data, develop realistic performance data, and to project data for several thermal storage concepts integrated into several solar thermal systems are summarized. Available thermal storage concepts were reviewed through a literature search, contacts, and contractors. A screening criteria was developed and schematics were made for these systems. Rough-order-of-magnitude costs were determined and candidate systems were further reduced. The remaining twenty systems were more fully developed.
M.D.K.

N82-24675# Sandia Labs., Livermore, Calif.
SOLAR THERMAL POWER STORAGE APPLICATIONS LEAD LABORATORY OVERVIEW
L. G. RADOSEVICH *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 84-88 Mar. 1981 Sponsored by DOE
Avail: NTIS HC A16/MF A01

An overview of activities for the applications elements of the Thermal Energy Storage for Solar Thermal Applications (TESSTA) program is presented. The TESSTA program which was initiated in FY80 is organized through a work breakdown structure which includes the development of thermal storage technologies matched to solar thermal power system requirements for several near-term applications. The status of the technology development activities ongoing in FY80 is presented here along with plans for FY81.
Author

N82-24679# State Univ. of New York, Buffalo. Dept. of Chemistry.
CORROSION BEHAVIOR OF ALLOYS
R. A. OSTERYOUNG and H. FERNANDEZ *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 102-103 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

Studies of molten nitrates at temperatures in the 450 - 550 C range were made to obtain information which will ultimately permit an understanding of the corrosion behavior of structural alloys, such as Incoloy 800, that will be employed in thermal loops in solar power systems. Initial activity will involve studies of species expected to exist in these melts from corrosion of structural alloys, i.e., iron, nickel and chromium.
Author

N82-24692# EIC, Inc., Newton, Mass.
A CHEMICAL HEAT PUMP BASED ON THE REACTION OF CALCIUM CHLORIDE AND METHANOL FOR SOLAR HEATING, COOLING AND STORAGE
P. O. OFFENHARTZ *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 154-158 Mar. 1981 Sponsored by DOE. Prepared in cooperation with Sandia Lab., Livermore, Calif. and Brookhaven National Lab., Upton, N.Y.
Avail: NTIS HC A16/MF A01

An engineering development test prototype of the CaCl2-CheOH chemical heat pump was tested. The unit, which has storage capacity in excess of 100,000 BTU, completed over 100 full charge-discharge cycles. Cycling data show that the rate of heat pumping depends strongly on the absorber-evaporator temperature difference. These rates are more than adequate for solar heating or for solar cooling using dry ambient air heat rejection. Performance degradation after 100 cycles, expressed as a contact resistance, was less than 2 C. The heat exchangers showed some warpage due to plastic flow of the salt, producing the contact resistance. The experimental COP for cooling was 0.52, close to the theoretically predicted value.
Author

N82-24719*# Tracor MB Associates, San Ramon, Calif.
PROCESS DEVELOPMENT FOR AUTOMATED SOLAR CELL AND MODULE PRODUCTION. TASK 4: AUTOMATED ARRAY ASSEMBLY Quarterly Report
J. J. HAGERTY 15 Jan. 1981 42 p
(Contract JPL-955699)
(NASA-CR-168923; JPL-9950-475; DOE/JPL-955600-81/02; NAS 1.26:168923; MBR-81/01; QR-2) Avail: NTIS HC A03/MF A01 CSCL 10A

The cell preparation station was installed in its new enclosure. Operation verification tests were performed. The detailed layout drawings of the automated lamination station were produced and construction began. All major and most minor components were delivered by vendors. The station framework was built and assembly of components begun.
Author

N82-24720*# General Electric Co., Cincinnati, Ohio. Advanced Energy Dept.
A CONCEPTUAL DESIGN STUDY OF A HIGH TEMPERATURE SOLAR THERMAL RECEIVER Final Report
C. S. ROBERTSON, C. L. EHDE, L. E. STACY, S. S. ABUJAWDEH, R. NARAYANAN, L. R. MCCREIGHT, A. GATTI, and H. W. RAUCH, SR. 4 Jan. 1980 160 p refs Prepared for JPL
(Contract JPL-955455)
(NASA-CR-168925; JPL-9950-483; NAS 1.26:168925; GEEP-66)
Avail: NTIS HC A08/MF A01 CSCL 10A

A conceptual design was made for a solar thermal receiver capable of operation in the 1095 to 1650 C (2000 to 3000 F) temperature range. This receiver is designed for use with a two-axis paraboloidal concentrator in the 25 to 150 kW sub t power range, and is intended for industrial process heat, Brayton engines, or chemical/fuels reactions. Three concepts were analyzed parametrically. One was selected for conceptual design. Its key feature is a helical coiled tube of sintered silicon nitride which serves as the heat exchanger between the incident solar radiation

and the working fluid. A mechanical design of this concept was prepared, and both thermal and stress analysis performed. The analysis showed good performance, low potential cost in mass production, and adaptability to both Brayton cycle engines and chemical/fuels production. B.W.

N82-24721*# Carnegie-Mellon Univ., Pittsburgh, Pa. Mechanical Engineering and Public Policy.
SAFETY AND LIABILITY CONSIDERATIONS FOR PHOTOVOLTAIC MODULES/PANELS
A. S. WEINSTEIN and D. G. MEEKER Jan. 1981 56 p refs Prepared for JPL
(Contract JPL-955846)
(NASA-CR-168938; DOE/JPL-955846-81/1; NAS 1.26:168938)
Avail: NTIS HC A04/MF A01 CSCL 10A

An overview of legal issues as they apply to design, manufacture, and use is presented. A methodology to be used during design of a photovoltaic module/array to minimize or eliminate perceived hazards is suggested. T.M.

N82-25111*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A SIMPLIFIED SOLAR CELL ARRAY MODELLING PROGRAM
R. D. HUGHES *In its* The Telecommun. and Data Acquisition Rept. p 167-165 15 Apr. 1982 refs
Avail: NTIS HC A09/MF A01 CSCL 10A

As part of the energy conversion/self sufficiency efforts of DSN engineering, it was necessary to have a simplified computer model of a solar photovoltaic (PV) system. This article describes the analysis and simplifications employed in the development of a PV cell array computer model. The analysis of the incident solar radiation, steady state cell temperature and the current-voltage characteristics of a cell array are discussed. A sample cell array was modelled and the results are presented. S.L.

N82-25296*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OPTICAL CHARACTERIZATION OF SOLAR CONCENTRATOR MIRRORS USING THE SOLAR BEAM OF THE JPL 25-FOOT SPACE SIMULATOR
M. J. ARGOUD and E. W. DENNISON *In* NASA. Goddard Space Flight Center 12th Space Simulation Conf. 19 p 1982
Avail: NTIS HC A15/MF A01 CSCL 22B

The Jet Propulsion Laboratory 25-foot space simulator with its 5.8-m (19-ft) diameter simulated solar beam provides an excellent facility for measuring the optical characteristics of parabolic solar concentrator panels and gores. The virtual source position and size were determined by using a single lamp of the 37 xenon 30-kW source array with only the center lens in the 19-channel optical mixer. This data was used to define the optical test geometry, and it allowed accurate measurement of focal length and surface deviations of the mirror under test. A flux distribution of a typical solar concentrator placed directly on the solar beam gives measurements of performance at the focal point of the parabolic surface. Author

N82-25409# Mid-American Solar Energy Complex, Minneapolis, Minn.
EVALUATION FOR FY 1981 OF MASEC'S RETROFIT RESIDENTIAL SINGLE-FAMILY DWELLINGS PASSIVE SOLAR HEATING PROJECT
Sep. 1981 6 p refs
(Contract DE-AC02-79CS-30150)
(DE82-001188; MASEC-R-81-031; P-102-5) Avail: NTIS HC A02/MF A01

The utilization of energy conserving techniques with passive and hybrid solar heating in the retrofit single family housing market is investigated. Processes were developed that result in a 50 percent reduction in space heating energy use for 25 percent of all existing single family housing. DOE

N82-25412# Mid-American Solar Energy Complex, Minneapolis, Minn.
DESCRIPTION OF FIVE HOUSES INSTRUMENTED FOR CLASS B ANALYSIS
Aug. 1981 23 p
(Contract DE-AC02-79CS-30150)
(DE82-001186; MASEC-R-81-015; P-101-3) Avail: NTIS HC A02/MF A01

The five houses to be monitored are described along with the instrumentation. Floor plans are shown. The progress of the equipment procurement, installation, and the monitoring itself is summarized. DOE

N82-25638*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FSA FIELD TEST Annual Report, Aug. 1980 - Aug. 1981
P. JAFFE, R. W. WEAVER, and R. E. LEE 15 Dec. 1981 49 p
(Contract NAS7-100; DE-AI01-76ET-20356)
(NASA-CR-168991; DOE/JPL-1012-59; JPL-PUB-81-99; NAS 1.26:168991) Avail: NTIS HC A03/MF A01 CSCL 10A

The 12 continental remote sites were decommissioned. Testing was consolidated into a five-site network consisting of the four Southern California sites and a new Florida site. 16 kW of new state-of-the-art modules were deployed at the five sites. Testing of the old modules continued at the Goldstone site but as a low-priority item. Array testing of modules is considered. Additional new testing capabilities were added. A battery-powered array data logger is discussed. A final set of failure and degradation data was obtained from the modules. Author

N82-25639*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DISH CONCENTRATORS FOR SOLAR THERMAL ENERGY: STATUS AND TECHNOLOGY DEVELOPMENT
L. D. JAFFE 1 Jan. 1982 69 p refs Presented at the 2nd Terrestrial Energy Systems Conf., Colorado Springs, 1-3 Dec. 1981
(Contract NAS7-100; DE-AT04-81AL-16228)
(NAS 1.26:168994) Avail: NTIS HC A04/MF A01 CSCL 10A

Point-focusing concentrators under consideration for solar thermal energy use are reviewed. These concentrators differ in such characteristics as optical configuration, optical materials, structure for support of the optical elements and of the receiver, mount, foundation, drive, controls and enclosure. Concentrator performance and cost are considered. Technology development is outlined, including wind loads and aerodynamics; precipitation, sand, and seismic considerations; and maintenance and cleaning. Author

N82-25641*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THERMAL PERFORMANCE OF A PHOTOGRAPHIC LABORATORY PROCESS: SOLAR HOT WATER SYSTEM
J. A. WALKER and R. N. JENSEN Apr. 1982 22 p
(NASA-TM-83299; NAS 1.15:83299) Avail: NTIS HC A02/MF A01 CSCL 10A

The thermal performance of a solar process hot water system is described. The system was designed to supply 22,000 liters (5,500 gallons) per day of 66 C (150 F) process water for photographic processing. The 328 sq m (3,528 sq. ft.) solar field has supplied 58% of the thermal energy for the system. Techniques used for analyzing various thermal values are given. Load and performance factors and the resulting solar contribution are discussed. S.L.

N82-25642*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATELLITE POWER SYSTEM. CONCEPT DEVELOPMENT AND EVALUATION PROGRAM. VOLUME 4: ENERGY CONVERSION AND POWER MANAGEMENT
Nov. 1981 366 p refs
(NASA-TM-58237; NAS 1.15:58237) Avail: NTIS HC A16/MF A01 CSCL 10A

Analyses performed for the satellite power system (SPS) reference system concept are presented. The reference concept together with descriptions of energy conversion, power distribution, and power management for solar photovoltaics, solar thermal, and concept comparisons are reviewed. Studies on energy conversion and power management (environmental impacts, annealing, nuclear SPS concept, and thermionic) are also reported. E.A.K.

N82-25646# Mid-American Solar Energy Complex, Minneapolis, Minn.
PASSIVE SOLAR CLASS B MONITORING REPORTS
Sep. 1981 35 p refs
(Contract DE-AC02-79CS-30150)
(DE82-003139; MASEC-R-81-016) Avail: NTIS HC A03/MF A01

A program for monitoring the performance of passive solar houses is briefly described relevant to the monthly monitoring reports. Equipment was installed in 3 houses, two in Iowa and one in Wisconsin. The required contents of the monthly reports are outlined, and monthly reports are included from one Iowa and one Wisconsin site. Information includes a site summary sheet elevation and floor plan sketches, weather summary, daily data printout and thermal comfort. DOE

N82-25647# Mid-American Solar Energy Complex, Minneapolis, Minn.
EVALUATION FOR FY 1981 OF MASEC'S NEW RESIDENTIAL MULTI-FAMILY DWELLING PASSIVE SOLAR HEATING PROJECT
Sep. 1981 6 p refs
(Contract DE-AC02-70CS-30150)
(DE82-001206; MASEC-R-81-037; P-103-6) Avail: NTIS HC A02/MF A01

The program to form teams to design and build one passive solar building is discussed. Documentation of the process and the conducting of workshops on its design, construction, and marketing is described. DOE

N82-25648# Mid-American Solar Energy Complex, Minneapolis, Minn.
QUARTERLY REPORT OF SOLAR FEDERAL BUILDINGS: PROGRAM IN THE MASEC REGION
Sep. 1981 26 p
(Contract DE-AC02-79CS-30150)
(DE82-001185; MASEC-R-81-059/2; A-104-6) Avail: NTIS HC A03/MF A01

Activities concerning the short course on solar and energy conservation for buildings are reviewed. DOE

N82-25649# Mid-American Solar Energy Complex, Minneapolis, Minn.
EVALUATION OF THE SOLAR CITIES PROGRAM
J. MUSUMECI Sep. 1981 10 p
(Contract DE-AC02-79CS-30150)
(DE81-030868; MASEC-R-81-044) Avail: NTIS HC A02/MF A01

The Grand Island Social Services Project, the Solar Utilities Conference, and Model Codes Workshops, and support services provided under this work package are described. Author

N82-25651# Mid-American Solar Energy Complex, Minneapolis, Minn.
SUMMARY OF COMMERCIAL DEMONSTRATION PROJECTS
Sep. 1981 44 p
(Contract DE-AC02-79CS-30150)
(DE82-002278; MASEC-PA-81-055) Avail: NTIS HC A03/MF A01

Problem areas and successes of eighteen solar energy demonstration project sites are summarized. The design and construction phase is discussed first and then the components where problems occurred during operation are discussed. DOE

N82-25653# Mid-American Solar Energy Complex, Minneapolis, Minn.
ANALYSIS OF THE SOLAR 80 PROGRAM IN FISCAL YEAR 1981
Sep. 1981 14 p
(Contract DE-AC02-79CS-30150)
(DE82-001190; MASEC-R-81-017) Avail: NTIS HC A02/MF A01

The Solar 80 Program is discussed in general. A review of existing solar houses is presented and the MASEC Solar 80 house design process is described. An evaluation of the Solar 80 program and products is also presented. DOE

N82-25654# Los Alamos Scientific Lab., N. Mex.
SOLAR ENERGY RESEARCH AT LOS ALAMOS Progress Report, 1 Oct. - 31 Dec. 1980
S. K. REISFELD, comp. and D. A. NEEPER, comp. Sep. 1981 55 p
(Contract W-7405-ENG-36)
(DE82-004222; LA-8984-PR) Avail: NTIS HC A04/MF A01

The performance of so-called sun-tempered buildings is under investigation. The thermal effects of water transpiration in the greenhouse of the Balcomb house are reported. The convective loop experiment shows that collector efficiency is nearly independent of the depth of the flow channels in the collector. Corrosion in liquid-cooled systems is being studied. Numerical modeling to investigate various methods for solar drying of sewage sludge, the existence of a boundary layer at the interface between the convecting and nonconvecting regions of a solar pond are discussed. Numerical analysis indicates that the convecting region will encroach upon the nonconvecting region when the temperature difference across the nonconvecting region exceeds a critical value. DOE

N82-25656# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
PILOT SOLAR POWER PLANT [PILOT-SOLARKRAFTANLAGE]
D. WOLF 1981 4 p Repr. from Erdoel u. Kohle - Erdgas - Petrochem. vereinigt mit Brennstoff-chem., v. 33, no. 8, Aug. 1980 p 343-344 In GERMAN
(MBB-UR-533-81-O) Avail: Issuing Activity

A fully functionally efficient solar-thermal power plant (10 kW electric) was built. The operating principle of thermomechanical conversion of solar energy into mechanical or electrical energy is presented. The equipment is completely automatic. Flat plate collectors absorb solar energy and convert it into heat which is transmitted by water to a heat exchanger. A closed cycle machine uses the heat to boil a working fluid (C2C12F4). A screw, powered by gas expansion in the working fluid, converts mechanical energy into electrical energy. Author (ESA)

N82-26458# Telic Corp., Santa Monica, Calif.
INVESTIGATION OF CONTINUOUS DEPOSITION OF AMA-TYPE COATINGS ONTO STRIP AND SHEET BY SPUTTERING Semiannual Technical Progress Report, 5 Sep. 1980 - 30 Nov. 1981
J. A. THORNTON and J. L. LAMB 1 Dec. 1981 62 p refs
(Contract DE-AC04-80AL-13116)
(DE82-004266; DOE/AL-13116/T1; TELIC-81-3) Avail: NTIS HC A04/MF A01

The continuous deposition of multilayer selective absorber coatings onto strip by planar magnetron sputtering was investigated.

Metal-layer materials other than Mo that might provide improved thermal stability in air were also examined. Cr, Mo, Ni, Ta, and a Pt/Al2O3 cermet were considered for use as the intermediate metal layer. In each case the same metal was also used for the low emittance base layer. The substrates were glass and stainless steel plates. Good spectral selectivity and emittance at 200 C of 0.10, was achieved on glass substrates for all of the materials. The thermal stabilities of the coatings confirm the earlier work and underscore the importance of the Al2O3 layer. Coatings on glass substrates with rf sputtered Al2O3 layers were stable in air to 500 to 6000 C and in vacuum to at least 650 to 7000 C; they appear attractive for medium and high temperature collectors. The Mo and Ni-based coatings with reactive sputtering Al2O3 were stable during 1000 hr-long tests in air at 3500 C and show promise as low cost coatings for low temperature flat plate collector applications. DOE

N82-26514# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DATA REPORT FOR THE NORTHEAST RESIDENTIAL EXPERIMENT STATION, SEPTEMBER 1981
M. C. RUSSELL, P. RAGHURAMAN, and P. C. MAHONEY Oct. 1981 13 p
(Contract DE-AC02-76ET-20279)
(DE82-005616; DOE/ET-20279/165) Avail: NTIS HC A02/MF A01

The residential experiment stations were designed to develop residential photovoltaic systems and to gather and disseminate performance data for the photovoltaic community, cognizant institutions and, ultimately, the public. Physical performance data obtained from photovoltaic energy systems are tabulated. DOE

N82-26699# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
QUALITY ASSURANCE AND STANDARDS PLAN FOR SOLAR THERMAL TECHNOLOGIES
H. R. W. COBB Jul. 1981 34 p refs
(Contract DE-AC02-77CH-00178)
(DE81-030831; SERI/RR-742-846) Avail: NTIS HC A03/MF A01

The development of a quality assurance and standards (QA and S) plan for the photovoltaic (PV) and domestic solar heating (SHAC) technologies preceded that for solar thermal technologies, permitting a review and lessons-learned approach to developing a solar thermal QA and S plan. It is noted that the state of the art for solar thermal technology is not as complicated or novel as PV and is better suited to engineering dialogues for input and implementation than SHAC. It is important to recognize the differences in legislative directives that influence the US Department of Energy's approach to the process of developing a QA and S plan. Specific legislative directives to develop criteria for PV and SHAC are replaced for solar thermal with directives to develop standards using a commercial approach. Accordingly, a series of standards matrices are proposed as the keystone to the plan which will identify the functions of components, subsystems and systems. DOE

N82-26776* National Aeronautics and Space Administration. Pasadena Office, Calif.
AUTOMOTIVE ABSORPTION AIR CONDITIONER UTILIZING SOLAR AND MOTOR WASTE HEAT Patent
Z. POPINSKI, inventor (to NASA) (JPL, California Inst. of Tech., Pasadena) 29 Dec. 1981 6 p Filed 30 Jul. 1980 Supersedes N80-29843 (18 - 20, p 2726) Sponsored by NASA
(NASA-CASE-NPO-15183-1; US-PATENT-4,307,575; US-PATENT-APPL-SN-173519; US-PATENT-CLASS-62-148; US-PATENT-CLASS-62-235.1; US-PATENT-CLASS-62-238.3; US-PATENT-CLASS-62-239; US-PATENT-CLASS-62-244; US-PATENT-CLASS-62-476) Avail: US Patent and Trademark Office CSCL 10A

In combination with the ground vehicles powered by a waste heat generating electric motor, a cooling system including a generator for driving off refrigerant vapor from a strong refrigerant absorbant solution is described. A solar collector, an air-cooled condenser connected with the generator for converting the refrigerant vapor to its liquid state, an air cooled evaporator connected with the condenser for returning the liquid refrigerant to its vapor state, and an absorber is connected to the generator and to the evaporator for dissolving the refrigant vapor in the weak refrigerant absorbant solution, for providing a strong refrigerant solution. A pump is used to establish a pressurized flow of strong refrigerant absorbant solution from the absorber through the electric motor, and to the collector.
Official Gazette of the U.S. Patent and Trademark Office

N82-26777* National Aeronautics and Space Administration. Pasadena Office, Calif.
EFFICIENCY OF SILICON SOLAR CELLS CONTAINING CHROMIUM Patent
A. M. SALAMA, inventor (to NASA) (JPL, California Inst. of Tech., Pasadena) 19 Jan. 1982 8 p Filed 11 Sep. 1980 Supersedes N80-32850 (18 - 23, p 3156) Sponsored by NASA
(NASA-CASE-NPO-15179-1; US-PATENT-4,311,870; US-PATENT-APPL-SN-185867; US-PATENT-CLASS-136-261; US-PATENT-CLASS-136-290; US-PATENT-CLASS-148-1.5; US-PATENT-CLASS-357-30; US-PATENT-CLASS-257-63; US-PATENT-CLASS-219-121LN) Avail: US Patent and Trademark Office CSCL 10A

Efficiency of silicon solar cells containing about one quadrillion atoms cu cm of chromium is improved about 26% by thermal annealing of the silicon wafer at a temperature of 200 C to form chromium precippitates having a diameter of less than 1 Angstrom. Further improvement in efficiency is achieved by scribing laser lines onto the back surface of the wafer at a spacing of at least 0.5 mm and at a depth of less than 13 micrometers to preferentially precipitate chromium near the back surface and away from the junction region of the device. This provides an economical way to improve the deleterious effects of chromium, one of the impurities present in metallurgical grade silicon mateial.
Official Gazette of the U.S. Patent and Trademark Office

N82-26785*# Science Applications, Inc., Golden, Colo.
AN OVERVIEW OF THE VALUE OF PARABOLIC DISH SOLAR THERMAL SYSTEMS IN INDUSTRIAL COGENERATION APPLICATIONS
Mar. 1982 152 p Prepared for JPL, Pasadena, Calif.
(Contract JPL-955908)
(NASA-CR-169063; NAS 1.26:169063) Avail: NTIS HC A08/MF A01 CSCL 10A

The essential elements of the cogeneration system configuration to be captured were the displacement of thermal energy by collection and use of the Brayton exhaust stream, and the sale back to the utility of any electricity production in excess of on-site requirements. In contrast to simply dumping these energy flows, their use or sale obviously serves, by itself, to increase gross value of the solar thermal energy system. Net allowable cost of the parabolic dish modules may or may not be increased, however. A consideration is that the waste heat capture and delivery subsystems are not free. This study does not address the incremental cost of adding waste heat capture, transport, and conversion (to steam, if necessary). It does compute a value for the thermal energy thereby displaced. This value can serve as a first-round input to any detailed economic evaluation of waste heat recovery. T.M.

N82-26786*# General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
INTEGRATED RESIDENTIAL PHOTOVOLTAIC ARRAY DEVELOPMENT Final Report
N. F. SHEPARD, JR. 11 Dec. 1981 155 p Sponsored in part by DOE
(Contract JPL-955894)
(NASA-CR-169042; DOE/JPL-955894-5; JPL-9950-660; NAS 1.26:169042) Avail: NTIS HC A08/MF A01 CSCL 10A

An advanced, universally-mountable, integrated residential photovoltaic array concept was defined based upon an in-depth formulation and evaluation of three candidate approaches which

were synthesized from existing or proposed residential array concepts. The impact of module circuitry and process sequence is considered and technology gaps and performance drivers associated with residential photovoltaic array concepts are identified. The actual learning experience gained from the comparison of the problem areas of the hexagonal shingle design with the rectangular module design led to what is considered an advanced array concept. Building the laboratory mockup provided actual experience and the opportunity to uncover additional technology gaps. Author

N82-26787*# Boeing Engineering and Construction, Seattle, Wash.

AIR BRAYTON SOLAR RECEIVER, PHASE 1 Final Report

D. K. ZIMMERMAN 5 Jan. 1979 110 p Prepared for JPL
(Contract JPL-955119)
(NASA-CR-169081; NAS 1.26:169081) Avail: NTIS HC A06/MF A01 CSCL 10A

A six month analysis and conceptual design study of an open cycle Air Brayton Solar Receiver (ABSR) for use on a tracking, parabolic solar concentrator are discussed. The ABSR, which includes a buffer storage system, is designed to provide inlet air to a power conversion unit. Parametric analyses, conceptual design, interface requirements, and production cost estimates are described. The design features were optimized to yield a zero maintenance, low cost, high efficiency concept that will provide a 30 year operational life. Author

N82-26793*# Westinghouse Research and Development Center, Pittsburgh, Pa.

SILICON DENDRITIC WEB MATERIAL Final Report

D. L. MEIER, R. B. CAMPBELL, L. J. SIENKIEWICZ, and P. RAI-CHOUDHURY Mar. 1982 88 p refs Sponsored in part by DOE
(Contract JPL-955624)
(NASA-CR-169053; DOE/JPL-955624-82/3; JPL-9950-684; NAS 1.26:169053) Avail: NTIS HC A05/MF A01 CSCL 10A

The development of a low cost and reliable contact system for solar cells and the fabrication of several solar cell modules using ultrasonic bonding for the interconnection of cells and ethylene vinyl acetate as the potting material for module encapulation are examined. The cells in the modules were made from dendritic web silicon. To reduce cost, the electroplated layer of silver was replaced with an electroplated layer of copper. The modules that were fabricated used the evaporated Ti, Pd, Ag and electroplated Cu (TiPdAg/Cu) system. Adherence of Ni to Si is improved if a nickel silicide can be formed by heat treatment. The effectiveness of Ni as a diffusion barrier to Cu and the ease with which nickel silicide is formed is discussed. The fabrication of three modules using dendritic web silicon and employing ultrasonic bonding for interconnecting cells and ethylene vinyl acetate as the potting material is examined. E.A.K.

N82-26794*# Solarex Corp., Rockville, Md.

PROCESS RESEARCH ON SEMIX SILICON MATERIALS (PROSSM) Quarterly Report, 1 Dec. 1981 - 28 Feb. 1982

J. H. WOHLGEMUTH and D. B. WARFIELD 28 Feb. 1982 28 p refs Sponsored in cooperation with DOE Prepared for JPL, Pasadena, Calif.
(Contract JPL-955902)
(NASA-CR-169049; DOE/JPL-955902-5; JPL-9950-683; NAS 1.26:169049; QR-5) Avail: NTIS HC A03/MF A01 CSCL 10A

A cost effective process sequence was identified, equipment was designed to implement a 6.6 MW per year automated production line, and a cost analysis projected a $0.56 per watt cell add-on cost for this line. Four process steps were developed for this program: glass beads back clean-up, hot spray antireflective coating, wave soldering of fronts, and ion milling for edging. While spray dopants were advertised as an off the shelf developed product, they were unreliable with shorter than advertised shelf life. S.L.

N82-26795*# ARCO Solar, Inc., Chatsworth, Calif. Module Design Dept.

DESIGN, FABRICATION AND TEST OF BLOCK 4 DESIGN SOLAR CELL MODULES. PART 2: RESIDENTIAL MODULE Final Report

T. L. JESTER Apr. 1982 36 p Sponsored in part by DOE
(Contract JPL-955403)
(NASA-CR-169158; NAS 1.26:169158; DOE/JPL-955402-82/12; JPL-9950-682) Avail: NTIS HC A03/MF A01 CSCL 10A

Design, fabrication and test of the Block IV residential load module are reported. Design changes from the proposed module design through three iterations to the discontinuance of testing are outlined. Author

N82-26796*# Westinghouse Research and Development Center, Pittsburgh, Pa.

LARGE-AREA SHEET TASK ADVANCED DENDRITIC WEB GROWTH DEVELOPMENT Annual Report, 23 Oct. 1980 - Oct. 1981

C. S. DUNCAN, R. G. SEIDENSTICKER, J. P. MCHUGH, R. H. HOPKINS, D. L. MEIER, and J. SCHRUBEN 2 Mar. 1982 89 p refs Sponsored in part by DOE Prepared for JPL, Pasadena, Calif.
(Contract JPL-955843)
(NASA-CR-169047; DOE/JPL-955843-82/1; NAS 1.26:169047)
Avail: NTIS HC A05/MF A01 CSCL 10A

Thermal models were developed that accurately predict the thermally generated stresses in the web crystal which, if too high, cause the crystal to degenerate. The application of the modeling results to the design of low-stress experimental growth configurations will allow the growth of wider web crystals at higher growth velocities. A new experimental web growth machine was constructed. This facility includes all the features necessary for carrying out growth experiments under steady thermal conditions. Programmed growth initiation was developed to give reproducible crystal starts. Width control permits the growth of long ribbons at constant width. Melt level is controlled to 0.1 mm or better. Thus, the capability exists to grow long web crystals of constant width and thickness with little operator intervention, and web growth experiments can now be performed with growth variables controlled to a degree not previously possible. T.M.

N82-26797*# Photowatt International, Inc., Tempe, Ariz.

DEVELOPMENT OF TECHNIQUE FOR AR COATING AND NICKEL AND COPPER METALLIZATION OF SOLAR CELLS. FPS PROJECT: PRODUCT DEVELOPMENT Quarterly Technical Report, 1 Oct. 1981 - 31 Mar. 1982

W. TAYLOR 15 Apr. 1982 16 p Sponsored in part by DOE
(Contract JPL-955986)
(NASA-CR-169055; DOE/JPL-955986-2; JPL-9950-673; NAS 1.26:169055; QTR-2; QTR-3) Avail: NTIS HC A02/MF A01 CSCL 10A

Printed nickel overplated with copper and applied on top of a predeposited silicon nitride antireflective coating system for metallizing solar cells was analyzed. The ESL D and E paste formulations, and the new formulations F, G, H, and D-1 were evaluated. The nickel thick films were tested after firing for stability in the cleaning and plating solutions used in the Vanguard-Pacific brush plating process. It was found that the films are very sensitive to the leaning and alkaline copper solutions. Less sensitivity was displayed to the neutral copper solution. Microscopic and SEM observations show segregation of frit at the silicon nitride thick film interface with loose frit residues after lifting off plated grid lines. E.A.K.

N82-26800*# General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
EFFECTS OFF SYSTEM FACTORS ON THE ECONOMICS OF AND DEMAND FOR SMALL SOLAR THERMAL POWER SYSTEMS Final Report, Dec. 1978 - Mar. 1980
Sep. 1981 198 p refs Sponsored in part by DOE Prepared for JPL, Pasadena
(Contract JPL-955273)
(NASA-CR-169043; DOE/JPL-955273-1; NAS 1.26:169043)
Avail: NTIS HC A09/MF A01 CSCL 10A

Market penetration as a function time, SPS performance factors, and market/economic considerations was estimated, and commercialization strategies were formulated. A market analysis task included personal interviews and supplemental mail surveys to acquire statistical data and to identify and measure attitudes, reactions and intentions of prospective SPS users. Interviews encompassed three ownership classes of electric utilities and industrial firms in the SIC codes for energy consumption. A market demand model was developed which utilized the data base developed, and projected energy price and consumption data to perform sensitivity analyses and estimate potential market for SPS. S.L.

N82-26801*# Applied Concepts Corp., Reston, Va.
USAF SOLAR THERMAL APPLICATIONS CASE STUDIES
18 Sep. 1981 65 p
(Contract JPL-955887)
(NASA-CR-169054; JPL-9950-669; NAS 1.26:169054;
TR-J01-02-81) Avail: NTIS HC A04/MF A01 CSCL 10A

The potential of solar energy technologies to meet mission related applications for process heat was investigated. The reduction of the dependence of military installations on fossil fuels by promoting the use of more abundant resources where liquid hydrocarbons and natural gas are now used is examined. The evaluation and utilization of renewable energy systems to provide process heat and space heating are emphasized. The application of thermal energy systems is divided into four steps: (1) investigation of the potential operational cost effectiveness of selected thermal technologies; (2) selection of a site and preliminary design of point focussing solar thermal plant; (3) construction and test of an engineering prototype; and (4) installation and operation of a solar thermal energy plant. E.A.K.

N82-26802*# RCA Labs., Princeton, N. J.
EVALUATION AND VERIFICATION OF EPITAXIAL PROCESS SEQUENCE FOR SILICON SOLAR-CELL PRODUCTION Final Program Summary Report
D. REDFIELD Nov. 1981 25 p refs Sponsored in part by DOE Prepared for JPL, Pasadena, Calif.
(Contract NAS7-100; JPL-955825)
(NASA-CR-169044; DOE/JPL-955825-81/3; NAS 1.26:169044)
Avail: NTIS HC A02/MF A01 CSCL 10A

To achieve the program goals, 28 minimodules were fabricated and tested, using 600 cells made from three-inch-diameter wafers processed by the sequence chosen for this purpose. Of these 600 cells, half were made from epitaxially grown layers on potentially low-cost substrates. The other half were made from commercial semiconductor-grade (SG), single-crystal silicon wafers that served as controls. Cell processing was normally performed on mixed lots containing significant numbers of each of these two types of wafers. After evaluation of the performance of all cells, they were separated by types for incorporation into modules that were to be tested for electrical performance and response to environmental stress. A simplified flow chart displaying this scheme, for quantities representing half of the planned total to be processed, is presented. T.M.

N82-26805*# Westinghouse Research and Development Center, Pittsburgh, Pa.
SILICON WEB PROCESS DEVELOPMENT Final Report
C. S. DUNCAN, R. G. SEIDENSTICKER, J. P. MCHUGH, M. E. SKUTCH, J. M. DRIGGERS, and R. H. HOPKINS Oct. 1981 159 p refs Sponsored in part by DOE
(Contract JPL-954654)
(NASA-CR-169050; NAS 1.26:169050; DOE/JPL-954654-80/13; JPL-9950-653) Avail: NTIS HC A08/MF A01 CSCL 10A

The silicon web process takes advantage of natural crystallographic stabilizing forces to grow long, thin single crystal ribbons directly from liquid silicon. The ribbon, or web, is formed by the solidification of a liquid film supported by surface tension between two silicon filaments, called dendrites, which border the edges of the growing strip. The ribbon can be propagated indefinitely by replenishing the liquid silicon as it is transformed to crystal. The dendritic web process has several advantages for achieving low cost, high efficiency solar cells. These advantages are discussed. T.M.

N82-26806*# Westinghouse Research and Development Center, Pittsburgh, Pa.
SILICON MATERIALS TASK OF THE LOW COST SOLAR ARRAY PROJECT: EFFECT OF IMPURITIES AND PROCESSING ON SILICON SOLAR CELLS Final Report
R. H. HOPKINS, J. R. DAVIS, A. ROHATGI, M. H. HANES, P. RAI-CHOUDHURY, and H. C. MOLLENKOPF (Hemlock Semiconductor Corp.) Feb. 1982 239 p refs Sponsored in part by DOE
(Contract JPL-954331)
(NASA-CR-169051; DOE/JPL-954331-82/13; JPL-9950-655; NAS 1.26:169051) Avail: NTIS HC A11/MF A01 CSCL 10A

The effects of impurities and processing on the characteristics of silicon and terrestrial silicon solar cells were defined in order to develop cost benefit relationships for the use of cheaper, less pure solar grades of silicon. The amount of concentrations of commonly encountered impurities that can be tolerated in typical p or n base solar cells was established, then a preliminary analytical model from which the cell performance could be projected depending on the kinds and amounts of contaminants in the silicon base material was developed. The impurity data base was expanded to include construction materials, and the impurity performace model was refined to account for additional effects such as base resistivity, grain boundary interactions, thermal processing, synergic behavior, and nonuniform impurity distributions. A preliminary assessment of long term (aging) behavior of impurities was also undertaken. S.L.

N82-26810# Westinghouse Research and Development Center, Pittsburgh, Pa.
RIBBON GROWTH OF SINGLE CRYSTAL GAAS FOR SOLAR CELL APPLICATION Final Report, 15 Aug. 1978 - 15 Aug. 1981
T. A. GOULD, R. G. SEIDENSTICKER, and R. MAZELSKY Wright-Patterson AFB, Ohio AFWAL Nov. 1981 77 p refs
(Contract F33615-78-C-2031; AF PROJ. 3145)
(AD-A112038; REPT-81-9F4-GARSH-R1; AFWAL-TR-81-2115)
Avail: NTIS HC A05/MF A01 CSCL 20B

This report describes the results of a 3-year effort to develop GaAs dendritic web for high-efficiency solar cells. A unique GaAs ribbon growth system was developed by applying dentritic-web growth techniques to a liquid-encapsulated GaAs system. Computerized thermal modelling and experimental modification produced a thermal geometry from which 48 GaAs webs were grown. These crystals had a multidendrite and/or faceted morphology rather than typical web morphology. Crystal quality improved as thermal geometry, growth techniques, dendrite seeds, and melt chemistry were optimized during the course of the program; however, conventional web morphology was not achieved. Analyses of chemical modification, crystal-growth characteristics, and orientation relationships suggest that inherent materials properties of GaAs produce a typical web morphology under conventional web-growth conditions. Consequently, a simple

transfer of Si web growth technology to our GaAs system was inadequate for the growth of high quality GaAs web. GRA

N82-26811# Coast Guard Research and Development Center, Groton, Conn.
LEAD-ACID BATTERIES IN SOLAR PHOTOVOLTAIC POWER SYSTEMS FOR MARINE AIDS TO NAVIGATION Final Report
S. E. TRENCHARD Oct. 1981 32 p refs
(AD-A112151; CGR/DC-29/81; USCG-D-04-82) Avail: NTIS HC A03/MF A01 CSCL 10C

Since 1974, the U.S. Coast Guard has been testing lead-acid batteries in solar photovoltaic-powered systems for aids to navigation. Three types of lead-acid batteries, distinguished by the composition of their grid material, have been tested: lead-antimony grid, lead-calcium grid, and pure-lead grid. This report contains a comparison of the charging characteristics and the charge-discharge cycling behavior of each grid type. All types were remarkably similar qualitatively in their daily as well as annual cycling behavior but the significance of the quantitative differences offer distinctive tradeoffs. This report presents models for water usage, depth-of-discharge, and post-cycle capacity for various levels of voltage regulation. Based on the post-cycle capacity tests, the effect of grid strength, grid thickness, and operating conditions on life expectancy are presented. A final discussion presents the results of a field deployment of solar photovoltaic-powered aids to navigation in the Miami, Florida area. Potential solutions to the battery terminal corrosion and bird guano problems observed are discussed. Author (GRA)

N82-26814# Automation Industries, Inc., Silver Spring, Md.
SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, GENERAL ELECTRIC - MILWAUKEE OPERATIONAL TEST SITE, MILWAUKEE, WISCONSIN, SEPTEMBER 1980 - MARCH 1981
R. G. HOWARD 1981 87 p refs
(Contract DE-AC01-79CS-30027)
(DE82-001934; SOLAR/2097-81/14) Avail: NTIS HC A05/MF A01

The active solar energy system for a recreation hall for senior citizens in Wisconsin, is equipped with 1290 square feet of evacuated tube collectors, 3000 gallons of water in a tank, and a natural gas fired furnace for auxiliary space heating and a natural gas fired domestic water heater. The solar fraction, solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance are given as well as performance data for the collector, storage, domestic hot water, and space heating subsystems, operating energy, energy savings, and weather conditions. Predicted performance data are also given for comparison with the measured data. DOE

N82-26815# Midwest Research Inst., Golden, Colo.
CALCULATED EFFECTS OF TEMPERATURE, INTENSITY AND ATMOSPHERIC CONDITIONS ON THE THERMODYNAMIC LIMITS FOR CONVERSION OF SOLAR ENERGY TO WORK ON STORED ENERGY
M. L. BUHL, JR., R. E. BIRD, R. V. BILCHAK, J. S. CONNOLLY, and J. R. BOLTON Aug. 1981 11 p refs
(Contract DE-AC02-77CH-00178)
(DE81-030876; SERI/TP-233-1382) Avail: NTIS HC A02/MF A01

AM1.15 spectra are used to determine thermodynamic limits on photochemical or photovoltaic conversion with emphasis primarily on the effects of variation of atmospheric conditions on the efficiencies. The conditions examined are: absorber temperature, total solar intensity, air mass, ozone and water-zone content of the atmosphere, and the turbidity and visibility of the atmosphere. In addition efficiencies are computed for the diffuse component of global radiation as an approximation to cloudy conditions. The results are displayed as plots of solar conversion efficiency vs. bandgap wavelength for each set of conditions. Conclusions are then drawn as to the important variants which can serve to guide the design of photochemical and/or photovoltaic systems for a given environment. DOE

N82-26817# Applied Solar Energy Corp., City of Industry, Calif.
IMPROVED SLICING METHOD FOR SILICON Final Report
S. I. SOCLOF and P. A. ILES Sep. 1981 43 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-003517; SERI/TR-9010-1-T1) Avail: NTIS HC A03/MF A01

Orientation dependent etching as an improved slicing method to provide thin silicon slices with increased yields and suitable for processing into high efficiency solar cells was investigated. Slicing of silicon by chemically etching narrow slots through silicon slabs was unsuccessful in that many slots did not etch completely through the slabs. The etch slicing method presented severe requirements on the materials used to mask against the etchants, on precise angular alignment for opening up lines in the masks, and on the crystallographic perfection of the silicon. The extremely small aspect ratio of the slots caused problems in the etching of the slots. A matrix processing sequence for processing strips formed by the etching process into solar cells is developed. DOE

N82-26824# Sandia Labs., Albuquerque, N. Mex.
LUMINESCENT SOLAR-CONCENTRATOR DEVELOPMENT Final Report, 31 Jan. - 30 Jun. 1979
P. S. FRIEDMAN Sep. 1981 148 p refs
(Contract DE-AC04-76DP-00789)
(DE82-000815; SAND-79-7059) Avail: NTIS HC A07/MF A01

Luminescent solar concentrators (LSCs) are studied. Characterization of LSC performance is emphasized. The areas investigated include the study of dyes in various hosts, development of an improved theoretical model for calculating efficiencies, investigation of both dye degradation and device operating temperatures, measurement of plate to cell optical coupling, photovoltaic cell optimization, use of inorganic glasses for LSCs, and a preliminary economic analysis. A collector efficiency of 1.9% was measured which represents approximately a 30% increase over previous values for the efficiency of an LSC coupled to a silicon photovoltaic cell. DOE

N82-26825# Automation Industries, Inc., Silver Spring, Md.
LOYOLA UNIVERSITY, NEW ORLEANS, LOUISIANA SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION, FEBRUARY 1981 - JUNE 1981
K. M. WELCH 1981 86 p refs
(Contract DE-AC01-79CS-30027)
(DE82-003357; SOLAR/1055-81/14) Avail: NTIS HC A05/MF A01

The Loyola University site is a student dormitory in New Orleans, Louisiana whose active solar energy system is designed to supply 52% of the hot water demand. The system is equipped with 4590 square feet of flat-plate collectors, a 5000-gallon water tank, auxiliary water supplied at high temperature and pressure from a central heating plant with a gas-fired boiler, and a differential controller that selects from 5 operating modes. System performance data are given, including the solar fraction, solar savings ratio, conventional fuel savings, system performance factor, and system coefficient of performance. The solar fraction is well below the design goal; this is attributed to great fluctuations in demand. Insolation, temperature, operation and solar energy utilization data are also presented. The performance of the collector, storage, and domestic hot water subsystems, the system operating energy, energy savings, and weather conditions are also evaluated. Appended are a system description, performance evaluation techniques and equations, site history, sensor technology, and typical monthly data. DOE

N82-26826# Automation Industries, Inc., Silver Spring, Md.
SUMMERWOOD ASSOCIATES, HOUSE M, OLD SAYBROOK, CONNECTICUT: SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION, JUNE 1980 - MAY 1981
M. RAYMOND 1981 105 p refs
(Contract DE-AC01-79CS-30027)
(DE82-002240; SOLAR/1102-81/14) Avail: NTIS HC A06/MF A01

The active solar energy system is designed to supply 78% of the space heating and 100% of the hot water loads. It is equipped with 378 square feet of flat plate collectors, a 600-gallon concrete storage tank, and for auxiliary heating, a heat pump and electrical resistance heater. The system and subsystem performance are measured, including the solar fraction, solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance. Also given are the system operating energy, energy savings, and weather conditions. DOE

N82-26827# Automation Industries, Inc., Silver Spring, Md.
SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION: GENERAL ELECTRIC, NORMAL OPERATIONAL TEST SITE, NORMAL, ILLINOIS, SEPTEMBER 1980 - MARCH 1981
S. J. FROCK 1981 86 p refs
(Contract DE-AC01-79CS-30027)
(DE82-001805; SOLAR/2098-81/14) Avail: NTIS HC A05/MF A01

This 2000 ft(2) single-family residence uses 356 ft(2) of evacuated tube collectors and a 380-gallon steel tank in the basement for solar space and water heating. An oil furnance provides auxiliary heating. The system provided 17% of the space heating and 42% of the water heating for the period. The problems incurred are mentioned. DOE

N82-26829# Automation Industries, Inc., Silver Spring, Md.
SOLAR-ENERGY-SYS[illegible] PERFORMANCE EVALUATION, RYMARK I AND RYMARK II, FREDERICK, MARYLAND, JANUARY 1981 - APRIL 1981
J. W. SPEARS 1981 90 p refs
(Contract DE-AC01-79CS-30027)
(DE82-001591; SOLAR/1106-81/14) Avail: NTIS HC A05/MF A01

The Rymark I and Rymark II sites are single family residences in Maryland with a passive solar heating system in Rymark II. The Rymark I system is equipped with 92 square feet of south-facing double-glazed windows and is designed to supply 16% of the heating load. The Rymark II system is equipped with 150 square feet of south-facing triple-pane windows and is designed to supply 28% of the heating load. Both houses are equipped with a 24,000 Btu heat pump. For each house, the equipment solar fraction and conventional fuel savings are given. Overall system performance data are presented as well as data on collector, storage, and space heating performance, energy savings, and weather conditions. DOE

N82-26830# Automation Industries, Inc., Silver Spring, Md.
SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, GENERAL ELECTRIC DALLAS OPERATIONAL TEST SITE, DALLAS, TEXAS, OCTOBER 1980 - MARCH 1981
P. E. WETZEL 1981 86 p refs
(Contract DE-AC01-79CS-30026)
(DE82-001350; SOLAR/2094-81/14) Avail: NTIS HC A05/MF A01

The General Electric-Dallas site is a single family residence in Texas. The active solar energy system is a retrofit designed to supply 60% of the heating load, 75% of the hot water load, and 50% of the cooling load. The system is equipped with 365 square feet of evacuated tube collectors, 400 gallons of solar hot water storage, a three-ton heat pump for auxiliary heating and cooling, and a gas-fired, 40-gallon, domestic hot water heater. The solar fraction, solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance are given, as well as performance data for the collector, storage, domestic hot water, space heating and space cooling subsystems, solar operating energy, energy savings, and weather conditions. Predicted performance data are given for comparison with the measured values. DOE

N82-26831# Automation Industries, Inc., Silver Spring, Md.
SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, GENERAL ELECTRIC SPOKANE OPERATIONAL TEST SITE, SPOKANE, WASHINGTON, OCTOBER 1980 - MARCH 1981
K. M. WELCH 1981 79 p refs
(Contract DE-AC01-79CS-30027)
(DE82-001610; SOLAR/2095-81/14) Avail: NTIS HC A05/MF A01

The General Electric-Spokane site is a YWCA building in Washington. The active solar energy system is designed to supply 45% of the heating load, 20% of the hot water load, and 60% of the pool heating load. It is equipped with 5,222 square feet of evacuated tube collectors, 6,700 gallons of water for heat storage, and an auxiliary natural gas-fired boiler. The solar fraction, solar savings ratio, conventional fuel savings, system performance factor, and solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance is given, as well as performance data for the collector, storage, domestic hot water, space heating and pool heating subsystems, operating energy, energy savings, and weather conditions. DOE

N82-26833# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
CONCEPTUAL DESIGN OF THE TRUSCOTT BRINE LAKE SOLAR-POND SYSTEM, VOLUME 1: UTILITY-INDEPENDENT SCENARIO
Jun. 1981 116 p refs Prepared for Army Corps of Engineers, Tulsa District
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-003024; SERI/TR-731-1202) Avail: NTIS HC A02/MF A01

A conceptual design was performed for a series of solar pond systems to provide pumping power for chloride control in the Red River Basin. In the chloride control project, briny waters are diverted so as not to pollute portable water. The diverted brine is stored in a dammed natural basin where, with the aid of natural evaporation, the brine is concentrated to the salinities required for the solar ponds. The brine is transferred to the ponds and injected at the proper levels to establish the gradients and storage layers. The solar ponds are to be located within the Truscott, Texas brine impoundment lake. Heat will be extracted from the ponds and used to drive organic Rankine-cycle turbine generators. The electricity produced will serve the pumping needs of the chloride control project, pump brine from the natural source to the evaporation ponds, pump concentrated brine from the evaporation ponds to the solar ponds, maintain the solar ponds, and supply all system parasitic loads. It was found that five solar ponds with eight organic Rankine-cycle turbine-generators would serve both the average and peaking power requirements of the pumping stations in the Truscott area as they come on-line. DOE

N82-26834# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
OPTICAL ANALYSIS AND OPTIMIZATION OF PARABOLIC-TROUGH COLLECTORS: A USER'S GUIDE
P. BENDT, A. RABL, and H. W. GAUL Jul. 1981 32 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-003146; SERI/TR-631-602) Avail: NTIS HC A03/MF A01

An optical analysis of parabolic trough solar collectors is summarized using universal graphs and curve fits. These graphs enable the designer of parabolic trough collectors to calculate the performance and to optimize the design with a simple hand calculator. The sensitivity of the optimization to changes in collector parameters and operating conditions is evaluated. DOE

N82-26836# Automation Industries, Inc., Silver Spring, Md.
OAKMEAD INDUSTRIES, SANTA CLARA, CALIFORNIA SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION OCTOBER 1980 - MAY 1981
P. A. PAKKALA 1981 113 p refs
(Contract DE-AC01-79CS-30027)
(DE82-002508; SOLAR/2076-81/14) Avail: NTIS HC A06/MF A01

The Oakmaad Industries solar energy system is a commercial office/manufacturing building in California equipped with 2622 square feet of liquid flat-plate collectors, 1675 square feet of Trombe wall glazing, a 6500-gallon steel storage tank, two gas-fired auxiliary space heating units and an auxiliary electric resistance water heater. The solar fraction, solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance are calculated. The performance of the collector, storage, domestic hot water and space heating subsystems is examined, and the operating energy and energy savings are tabulated. Weather conditions are tabulated for the site. DOE

N82-26837# Vitro Labs., Silver Spring, Md.
RHRU CLEMSON, CLEMSON, SOUTH CAROLINA: SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, NOVEMBER 1980 - MAY 1981
P. W. KENDALL 1981 105 p refs
(Contract DE-AC01-79CS-30027)
(DE82-002692; SOLAR-2086-81/14) Avail: NTIS HC A06/MF A01

The hybrid solar energy system is composed of a flat plate collector and greenhouse, and is designed to service the space heating and domestic hot water load while providing an environment for home food production. The equipment features a 388 square foot collector and 1161 cubic feet of crushed rock located under the building. The auxiliary equipment consists of electric resistance heaters for space heating and electric immersion heaters for domestic hot water. Detailed data on the energy savings realized from operation of the system from November 1980 to May 1981 are presented. Flow sheets show the flow of solar energy through the RHRU Clemson. Weather data for the Clemson area are given. DOE

N82-26838# Sandia Labs., Albuquerque, N. Mex.
CUSTOM ENGINEERING PARABOLIC GLASS REFLECTOR FOR THE SANDIA PROTOTYPE SOLAR COLLECTOR
J. OTTS and D. SALLIS (Custom Engineering, Inc.) Aug. 1981 56 p
(Contract DE-AC04-76DP-00789)
(DE82-000800; SAND-81-1619) Avail: NTIS HC A04/MF A01

The design and construction of a parabolic glass reflector is described. A brief summary of its performance as part of the Sandia prototype trough solar collector system is given. DOE

N82-26839# Sandia Labs., Albuquerque, N. Mex.
DEVELOPMENT AND TESTING OF A HIGH-EFFICIENCY/HIGH-CONCENTRATION, PHOTOVOLTAIC MODULE EMPLOYING ALGAAS/GAAS SOLAR CELLS
R. J. OWEN, N. KAMINAR, P. G. BORDEN, P. E. GREGORY, and O. E. MOORE Oct. 1981 204 p refs Prepared in cooperation with Varian Associates, Inc., Palo Alto, Calif.
(Contract DE-AC04-76DP-00789)
(DE82-002683; SAND-81-7018) Avail: NTIS HC A10/MF A01

An advanced photovoltaic module employing high-concentration (400 suns) Fresnel lenses, high efficiency AlGaAs/GaAs solar cells, and jet-impingement cell cooling was designed. The prototype module produced approximately 100 W of dc power using 12 organometallic-vapor phase epitaxial (OM-VPE) cells (21 to 23% efficiency at 400 suns, 500 C) and 12 acrylic lenses and as designed for thermal energy recovery. The maximum module efficiency measured in Palo Alto, CA, was 17.1% compared to the 14% design goal. This performance was at 500 C coolant inlet temperature and reflected deduction of coolant pumping power. The module efficiency is 17.5% when corrected to NOCT conditions (200 C coolant inlet temperature). Approximately 40 to 50% of the direct normal incident energy was determined to be available for recovery from the module coolant. The design and performance of a 3.2 kW/sub p/ photovoltaic array employing a further improved version of the module is also presented. DOE

N82-26840# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
ELECTROCHEMICAL PHOTOVOLTAIC CELLS 2-6 COMPOUND THIN FILM ELECTRODES Annual Report, Jun. 1980 - Jun. 1981
M. A. RUSSAK, J. REICHMAN, J. DECARLO, and C. CRETER Jul. 1981 47 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-77CH-00178)
(DE82-000394; GAC-RM-728; SERI/PR-8002-8-T) Avail: NTIS HC A03/MF A01

The program focused on developing stable, thin film II-VI compound electrodes with sunlight efficiencies of 10%, for use with aqueous polysulfide electrolyte in frontwall and backwall illuminated electrochemical photovoltaic cells. The main effort was directed towards establishing the relationships among processing of the thin films, resultant electronic properties, and I-V performance in order to produce electrodes with maximum power conversion efficiency. The efficiency of n-CdSe electrodes deposited on titanium substrates was improved from between 3 to 5% to 5.5% to 6.5% by refinement of the thin film processing parameters as well as electrode surface treatment with ZnCl2 solution. The efficiency of n-CdSe electrodes deposited on tin oxide coated glass improved was from between 3 to 4% to the range of 6 to 6.5% due to modifications of the electrode geometry dictated by a photon loss minimization, and to electrode etching treatment. T.M.

N82-26842# Midwest Research Inst., Kansas City, Mo. Solar Energy Research Inst.
STATE SOLAR INITIATIVES. VOLUME 1: A REVIEW
R. KOONTZ, J. NEUENDORFFER, B. GREEN, N. GORDON, G. MYRING, E. PERWIN, B. POSTER, D. SMALL, and L. MYRING Sep. 1981 73 p refs 2 Vol.
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-002425; SERI/TR-722-882-VOL-1) Avail: NTIS HC A04/MF A01

The impacts of solar energy programs undertaken in California, Florida, New Mexico, Minnesota, and New York are reviewed. Initiatives were explored: information outreach activities; consumer protection programs including standards, testing, certification, warranties, licensing, and consumer complaint offices; and tax credits and rebates. The experience in these five states is analyzed and conclusions and recommendations that will assist state governments in improving or launching their own programs are presented. DOE

N82-26843# Midwest Research Inst., Kansas City, Mo. Solar Energy Research Inst.
STATE SOLAR INITIATIVES. VOLUME 2: A REVIEW
R. KOONTZ, J. NEUENDORFFER, B. GREEN, G. MYRING, L. MYRING, E. PERWIN, N. GORDON, D. SMALL, and B. POSTER Sep. 1981 144 p refs 2 Vol.
(Contract DE-AC02-77CH-00178)
(DE82-002838; SERI/TR-722-882-VOL-2) Avail: NTIS HC A07/MF A01

Background material supporting the solar energy recommendations and conclusions is provided. Research methodology, results of a computer program on state and federal tax credits, state energy goals, program lists, energy and demographic factors are contained. DOE

N82-26850# Trinity Univ., San Antonio, Tex.
RESULTS OF ROOF POND HEATING EXPERIMENTS USING THE PASSIVE TEST FACILITY FOR WARM, HUMID CLIMATES
F. M. LOXSOM, P. OLIVARES, B. KELLY, E. CLARK, E. DODERER, and P. HAYES Sep. 1981 348 p refs
(Contract DE-AC03-79CS-30201)
(DE82-003226; DOE/CS-30201/T4) Avail: NTIS HC A15/MF A01

Passive cooling and heating methods in warm, humid climates were tested. During the winter of 1980-1981, heating experiments were carried out for roof pond systems. These experiments included: roof pond heating with glazed and unglazed water bags, heating roof ponds from below by using reflective blinds in south facing windows, and direct gain heating with the roof pond used as storage. The data for these experiments are in the form of 5 minute data for 160 sensors. Most of the sensors are thermocouples or heat flux meters. The data are stored on computer type in the form of 28 different data files for 28 different experiment periods. DOE

N82-26856# Boeing Computer Services, Inc., Seattle, Wash.
INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 3: FOR NEWMAN POWER STATION, EL PASO, TEXAS Monthly Report, Feb. 1981
Albuquerque, N. Mex. Sandia National Labs. Sep. 1981 48 p refs
(Contract DE-AC04-76DP-00789)
(DE82-000797; SAND-81-7086/3) Avail: NTIS HC A03/MF A01

Performance data are listed and graphed for an intermediate photovoltaic system for a power station in Texas. The array energy production incident solar energy, and array efficiency are given for each month, and the daily energy production and efficiency, and energy as a function of power and of voltage are graphed. Insolation, heating and cooling loads, temperature and wind data, and the number of freeze-thaw cycles are given for each month. DOE

N82-26857# Booz-Allen and Hamilton, Inc., Bethesda, Md.
SOLAR CENTRAL RECEIVERS: THE TECHNOLOGY, INDUSTRY, MARKETS, AND ECONOMICS
1 Sep. 1981 155 p
(Contract DE-AC03-81SF-11436)
(DE82-005267; DOE/SF-11436/2) Avail: NTIS HC A08/MF A01

Major solar central receiver (SCR) technology development occurring in the public and private sectors is assessed. The economic characteristics of SCR systems are discussed and their ability to compete with conventional system costs is evaluated. The effects of various federal assistance options on the market prospects for SCR are quantified. The forms of possible federal assistance, impacts of such assistance on SCR costs, and the preference of potential SCR suppliers and purchasers towards these assistance options are identified. An overview is presented of private sector developers from which a viable supply industry can evolve and their capabilities to commercialize SCR techniques. DOE

N82-26859# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SHARED INVERTER RESIDENTIAL PHOTOVOLTAIC SYSTEM CONCEPT
E. C. KERN and F. J. SOLMAN Nov. 1981 9 p
(Contract DE-AC02-76ET-20279)
(DE82-006281; DOE/ET-20279/169) Avail: NTIS HC A02/MF A01

A residential photovoltaic system concept involving a number of separate roof mounted arrays all connected to a single utility interactive inverter is proposed and analyzed to compare systems employing one inverter for each array. The significance is that such shared inverter systems offer a costs savings of approximately 10%. It is observed that other substantial benefits might derive from a reduction in the number of tie in points between distributed generators and the electric utility grid. DOE

N82-26861# Pennsylvania Univ., Philadelphia. School of Public and Urban Policy.
SOLAR ENERGY HOT WATER HEATING AND ELECTRIC UTILITIES. A MODEL VALIDATION Final Report
Oct. 1981 41 p
(Contract DE-AC02-80CS-30438)
(DE82-005485; DOE/CS-30438/T1) Avail: NTIS HC A03/MF A01

TRNSYS is a residential solar simulation program designed to provide detailed simulations of individual solar systems composed of almost any presently used residential solar technology. The model is described and a validation of the model is presented using a group of domestic solar hot water systems in the metropolitan Philadelphia area. The collection and reduction of the data used is discussed, and the TRNSYS modeling of the systems is presented. The model results are given and a sensitivity analysis of the models was performed to determine the effect of input changes on the electric auxiliary backup consumption. DOE

N82-26863# Gibbs and Hill, Inc., New York.
SOLAR-CENTRAL-RECEIVER SYSTEM INTEGRATED WITH A COGENERATION FACILITY FOR COPPER SMELTING, VOLUME 1 Final Report
Aug. 1981 145 p
(Contract DE-AC03-81SF-11533)
(DE82-001580; DOE/SF-11533/T1-VOL-1) Avail: NTIS HC A07/MF A01

A cavity central receiver hybrid solar cogeneration retrofit for a smelting facility producing copper and sulfuric acid is described. Existing facilities and the southwest New Mexico site and the process for selection of the system configuration and subsystem criteria are described. The process involves: performance analyses, cost estimates, economic tradeoffs, and vendor quotations and consultation. An air based central receiver was selected, and sensible heat storage in rock is considered. A discounted cash flow analysis based upon the results of the conceptual design performance and cost estimates is performed. DOE

N82-26865# AAI Corp., Baltimore, Md.
SOLAR PRODUCTION OF INDUSTRIAL-PROCESS HOT WATER. PHASE 3: OPERATION AND EVALUATION OF THE YORK BUILDING PRODUCTS CO., INC. SOLAR FACILITY Final Report, Sep. 1978 - Sep. 1981
J. M. BOLLINGER, N. KAPLAN, and H. A. WILKENING, JR. Oct. 1981 95 p refs
(Contract DE-AC03-76CS-31217)
(DE82-003526; DOE/CS-31217/T8) Avail: NTIS HC A05/MF A01

A solar heating system to provide hot water for curing concrete blocks is discussed. The objective is to operate, collect data, and evaluate the solar system for a 3 year period. The solar facility utilizes 35 collectors. The system is designed to deliver a water/ethylene glycol solution at 2000 F to a heat exchanger, which, in turn, supplies water at 1800 F to a rotorclave (underground tank) for the concrete block curing process. A fossil fuel boiler system also supplies the rotorclave with processed hot water to supplement the solar system. The program demonstrates the technical feasibility of generating industrial process hot water with solar energy. DOE

N82-27026# Sandia Labs., Albuquerque, N. Mex. Systems Development Div.
USER'S MANUAL FOR DELSOL2: A COMPUTER CODE FOR CALCULATING THE OPTICAL PERFORMANCE AND OPTIMAL SYSTEM DESIGN FOR SOLAR-THERMAL CENTRAL-RECEIVER PLANTS
T. A. DELLIN, M. J. FISH, and C. L. YANG Aug. 1981 76 p refs Prepared in cooperation with Sandia National Labs., Livermore
(Contract DE-AC04-76DP-00789)
(DE82-003875; SAND-81-8237) Avail: NTIS HC A05/MF A01

DELSOL2 is a revised and substantially extended version of the DELSOL computer program for calculating collector field performance and layout, and optimal system design for solar thermal central receiver plants. The code consists of a detailed model of the optical performance, a simpler model of the non-optical performance, an algorithm for field layout, and a searching algorithm to find the best system design. The latter two features are coupled to a cost model of central receiver components and an economic model for calculating energy costs. The code can handle flat, focused and/or canted heliostats, and external cylindrical, multi-aperture cavity, and flat plate receivers. The program optimizes the tower height, receiver size, field layout, heliostat spacings, and tower position at user specified power levels subject to flux limits on the receiver and land constraints for field layout. The advantages of speed and accuracy characteristic of Version I are maintained in DELSOL2. DOE

N82-27378*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
POWER SYSTEMS INTEGRATION
L. W. BRANTLEY *In* NASA. Lewis Research Center Large Space Systems/Propulsion Interactions p 239-255 Jun. 1982 Avail: NTIS HC A12/MF A01 CSCL 22B

Power systems integration in large flexible space structures is discussed with emphasis upon body control. A solar array is discussed as a typical example of spacecraft configuration problems. Information on how electric batteries dominate life-cycle costs is presented in chart form. Information is given on liquid metal droplet generators and collectors, hot spot analysis, power dissipation in solar arrays, solar array protection optimization, and electromagnetic compatibility for a power system platform.
R.J.F.

N82-27545# Ruetgerswerke A.G., Frankfurt am Main (West Germany).
SOLAR EQUIPMENT SYSTEM PACKAGES FOR OLD AND NEW BUILDINGS TO PROVIDE DOMESTIC WATER AND PARTIAL HEATING Final Report
G. BERG and F. J. MUELLER Bonn Bundesministerium fuer Forschung und Technologie Mar. 1982 87 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-029; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18,30

Technically optimized and economically marketable system packages were investigated. Commercially available flat roof collectors failed long term (2 yr) tests. Architecturally, it is difficult to integrate the collectors into roof or wall surfaces due to their box design. Satisfactory integration is only achieved by including collectors in new building plans. Alternatively, a highly efficient plastic collector with long service life was developed. Although initial expenditure with conventional building construction is high, an improved cost-benefit relation is obtained, incorporating the flexible mat-shaped plastic absorber with fully wetted surface which is operated at pressure below atmospheric. Pilot plant results with a bivalent heat pump system prove collector capability. Design data for the absorber circuit and heat pump system are given.
Author (ESA)

N82-27835*# IIT Research Inst., Chicago, Ill. Technology Transfer and Market Research Section.
DOE/NASA SIMS PROTOTYPE SOLAR SYSTEM, NO. 4. PART 1: MARKET ANALYSIS. PART 2: MODULAR MANUFACTURING COST ESTIMATE
Dec. 1979 105 p refs Original document contains color photographs
(Contract NASW-2837; NAS8-32229; NAS 1.26:169216; NASA-CR-169216)
Avail: NTIS HC A06/MF A01 CSCL 10B

The findings of the IIT Research Institute (IITRI) market study of the SIMS Prototype System 4, a hot water (DHW) system are documented. The feasibility of prepackaging currently available solar heating components into modular subsystems for site assembly is addressed. A documented design and installation procedure and a performance test report were prepared. The potential markets and applications for this particular system in the nonfederal market are profiled by assessing the needs and requirements of potential users and specifiers, by characterizing the nature of the market and the competitive environment, by identifying the barriers to commercial acceptance, and by estimating the size of the potential market.
Author

N82-27836*# General Electric Co., Philadelphia, Pa. Energy Systems and Technology Div.
INTEGRATED RESIDENTIAL PHOTOVOLTAIC ARRAY DEVELOPMENT Quarterly Report
N. F. SHEPARD, JR. 17 Feb. 1981 65 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955894-1)
(NASA-CR-169112; JPL-9950-508; DOE/JPL-955894-1; NAS 1.26:169112; QR-1) Avail: NTIS HC A04/MF A01 CSCL 10A

An optimum integrated residential photovoltaic array/module is addressed. Nineteen existing or proposed systems intended for residential applications are described. Each of these systems is rated against a comprehensive set of evaluation criteria in an effort to formulate three module design concepts for further study and analysis. This evaluation led to a number of observations which are enumerated and should be considered in future module and array designs. Three module concepts are presented as baseline design approaches to be further analyzed and optimized. These options include: (1) a rectangular, direct mounted, shingle type module; (2) an integrally mounted module with nonconductive exposed elements; and (3) an aluminum framed, stand off module. Preliminary design drawings are presented for each of these module configurations.
Author

N82-27840# Coast Guard Research and Development Center, Groton, Conn.
ACCELERATED STRESS TESTING OF SOLAR PHOTOVOLTAIC MODULES Interim Report
S. E. TRENCHARD Sep. 1981 29 p refs
(AD-A107378; CGR/DC-25/81; USCG-D-59-81) Avail: NTIS HC A03/MF A01 CSCL 10B

The history of accelerated stress testing of solar photovoltaic modules is traced. The military standard tests to which the prototype modules were exposed and the results of that exposure are described. The evolution of the simultaneous multiple stress test to the present marine environment screening test is outlined. The results of exposure to the marine environment screening test of 136 test modules are reported.
Author

N82-27847# Insights West, Inc., Los Angeles, Calif.
FUEL FROM THE SUN: SOLAR COMMERCIAL AND INDUSTRIAL APPLICATIONS FOR THE 1960'S
Sep. 1981 51 p refs
(Contract DE-AC02-79CS-30159)
(DE82-003285; WSUN-74) Avail: NTIS HC A04/MF A01

The use of solar energy for industrial and commercial applications, particularly process heat, is presented. Flat plate, evacuated tube, and parabolic trough solar collectors are described briefly, and their temperature ranges and costs are given. Other solar technologies, including biomass conversion, wind power, solar

ponds, photovolttaics, and passive design are also discussed. A checklist is given to help determine the feasibility of a solar heating system for a particular application. Economic aspects of using a solar energy system are discussed. Information is given on the installation and operation of a solar energy system, including the question of solar access. DOE

N82-27852# California Univ., Livermore. Lawrence Livermore Lab.
PHOTOVOLTAICS: CURRENT STATUS AND FUTURE PROJECTIONS
D. W. DORN 19 Oct. 1981 14 p refs
(Contract W-7405-ENG-48)
(DE82-002684; UCID-19222) Avail: NTIS HC A02/MF A01

The generation of electricity by photovoltaic means was examined. Projections of near future developments are made, together with estimates of their impact on the cost and availability of photovoltaic systems for various markets. This concluded that photovoltaic systems should be able to deliver electricity at a cost of between 5 to 10 cents per kilowatt hour by 1986. DOE

N82-27854# Satzler (Ron), Princeville, Ill.
LOW COST, MULTIPURPOSE SOLAR ENERGY SYSTEM
R. SATZLER 5 Aug. 1981 22 p
(Contract DE-FG02-79R5-10108)
(DE81-030955; DOE/R5-10108/2) Avail: NTIS HC A02/MF A01

A solar heating system is described using 3500 ft(2) of solar air heater collectors and 85 tons of rock storage. The system is designed for farm use and the following five purposes are discussed: grain drying, house heating, house cooling, domestic water heating, and workshop heating. DOE

N82-27855# Architects Taos, N. Mex.
PASSIVE SOLAR HEATING SYSTEM Final Technical Report
W. MINGENBACH 28 Aug. 1981 139 p refs
(Contract DE-FC03-77CS-31513; EG-77-A-03-1513)
(DE82-003269; DOE/CS-31513/T1) Avail: NTIS HC A07/MF A01

The Toes State Office Building is a single-story office building in New Mexico which incorporates passive collection and storage of solar energy along with natural lighting for general illumination. The building is oriented to take advantage of early morning sunlight and is designed to supply 70% of the heating load by solar heat. The site is equipped with clerestory windows, totaling 2695 square feet, 296 square feet of south facing windows, and east and west window scoops totaling 218 square feet. The collected solar energy is stored in 14,080 gallons of water contained in drums located in the clerestory area, as well as in the masonry construction mass. Auxiliary heat is provided via electric strips in the supply ducts. Movable, insulated shutters are provided to reduce the loss from the clerestory window area at night. The project is described with pictures and diagrams of the final installation provided. An updated performance data report is included, and functional problems, general comments, maintenance and refurbishment recommendations are discussed. DOE

N82-27858# National Academy of Sciences - National Research Council, Washington, D. C.
ELECTRIC POWER FROM ORBIT: A CRITIQUE OF A SATELLITE POWER SYSTEM
R. KASPER 1981 350 p refs
(Contract NSF PRM-79-19687)
(PB82-133083; NSF/PRM-81004) Avail: NTIS HC A15/MF A01 CSCL 10B

As a basis for assessing feasibility and projecting costs, this study focuses on the elements of a reference system which includes conceptual designs of various space vehicles and construction bases. The system uses photovoltaic devices for energy conversion in space and microwave devices for energy transmission to Earth. In addition to the major conclusions of the study, a number of detailed findings and recommendations are presented. These cover important technological aspects of a satellite power system--economic analyses; environmental concerns; sociopolitical aspects of development; and a comparison of a satellite power system with potentially competing technologies that have prospects for meeting very long-term needs for electricity. GRA

N82-27908# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
TERRESTRIAL SOLAR SPECTRA, SOLAR SIMULATION AND SOLAR CELL EFFICIENCY MEASUREMENT
R. MATSON, R. BIRD, and K. EMERY Sep. 1981 121 p refs
(Contract EG-77-C-01-4042; DE-AC02-77CH-00178)
(DE82-002082; SERI/TR-612-964) Avail: NTIS HC A06/MF A01

Fundamentals of light transmittance and, both measured and modeled atmospheric effects (i.e., air mass, molecular and aerosal scattering, and absorption) on terrestrial solar spectra are discussed. Geometric effects, such as global rather than direct beam measurements, and detector orientation are also reviewed. The SERI proposed ASTM global and direct beam terrestrial solar spectra are also presented. A detailed review/evaluation of the spectral characteristics of a number of solar simulators is given. Methods of calibrating the short circuit current of a solar cell with respect to a given irradiance spectrum are discussed. In conclusion, the need for a sophisticated solar simulator is proportional to the spectral mismatch betwen the spectral response of the reference cell used to set the solar simulator and that of the test cell. The ASTM terrestrial solar irradiance spectrum is recommended as a reference, spectrum and, the used either filtered xenon arc or dichroic filtered tungsten halogen lamps for solar simulation is also recommended. DOE

03

HYDROGEN

Includes hydrogen production, storage, and distribution.

A82-31986#
VERY LARGE AIRCRAFT WITH ALTERNATE FUELS - LH2 MOST PROMISING
J. C. MUEHLBAUER (Lockheed-Georgia Co., Marietta, GA) American Institute of Aeronautics and Astronautics, International Very Large Vehicles Conference, 2nd, Washington, DC, May 17, 18, 1982, 10 p. refs
(AIAA PAPER 82-0813)

Optimum designs of cargo aircraft using alternate fuels and carrying large payloads roundtrip over transoceanic distances without refueling are developed and compared. Synthetic jet propulsion (JP) fuel, liquid hydrogen (LH2) fuel, and nuclear power are considered. In relation to the JP aircraft, the LH2 aircraft is found to have lower ramp weights (by 25%) and lower trip costs (15%). The ramp weights and trip costs of the nuclear aircraft are, respectively, approximately 5 and 20% higher than those for the JP aircraft. With JP aircraft trip costs the most sensitive to fuel price, it is believed that rising prices in the future will make LH2 and nuclear power increasingly attractive. C.R.

A82-31987#
THE POTENTIAL FOR LONG-RANGE HIGH-PAYLOAD AIRCRAFT WITH ALTERNATE FUELS
W. M. HAWKINS (Lockheed Corp., Burbank, CA) American Institute of Aeronautics and Astronautics, International Very Large Vehicles Conference, 2nd, Washington, DC, May 17, 18, 1982, 7 p. refs
(AIAA PAPER 82-0814)

It is assumed that these aircraft will not be produced until the year 2005 and that they will use liquid hydrogen, which can be produced using coal, natural gas, or any other source of energy and water. With regard to propulsion, the present size of modern

high-by-pass engines will be employed; between 6 and 12 such units will be used on each aircraft. Control systems in use today to relieve structural loads will figure in the design, as will controls to avoid flutter, which at present are under development. Also considered possible is the use of precision rendezvous. It is pointed out that the cooling capacity of the liquid hydrogen fuel may be able to maintain laminar flow over a substantial portion of the aircraft by surface cooling. C.R.

A82-32159
HYDROGEN ECONOMY ASSESSMENT FOR LONG-TERM ENERGY SYSTEMS IN JAPAN
T. OHTSUKA (Tohoku University, Sendai, Japan), M. AKIYAMA, T. SAITO, Y. ISHIZAKI, A. SUZUKI (Tokyo, University, Tokyo, Japan), N. NEGISHI, J. MORIYA, K. HOASHI, and T. HOSHINO (Industrial Research Institute, Tokyo, Japan) International Journal of Hydrogen Energy, vol. 7, no. 6, 1982, p. 455-462.

An assessment is made of hydrogen technology development; in particular, economy as an energy carrier, applicability for end-uses and the potential of the market in the future. Specifically, rough static cost comparisons are made on several modes of electricity transmission and hydrogen transport, and on several ways of off-peak electricity saving; including energy storage in the form of hydrogen. Then, the quantity of oil that could be saved from some representative end-use sectors if hydrogen fuel were to be introduced is discussed. Finally, a potential market is assessed, by projecting overall future energy supply/demand dynamics in Japan. (Author)

A82-32164
COOPERATIVE INTERNATIONAL LIQUID HYDROGEN AUTOMOTIVE PROGRESS REPORT
W. J. D. ESCHER (Escher-Foster Technology Associates, Inc., St. Johns, MI) International Journal of Hydrogen Energy, vol. 7, no. 6, 1982, p. 519-521.

The current status of cooperative projects undertaken in West Germany, the United States and Japan for the road testing of liquid-hydrogen-fuelled passenger automobiles is indicated. The German vehicle uses a 1.8-l displacement, four-stroke cycle, four-cylinder normally aspirated engine using hydrogen injection at the individual intake valve ports and electronically controlled water induction to suppress backfiring and NO(x) emissions. A semiautomatic liquid hydrogen refueling system has been developed which prechecks, fills and automatically terminates filling of the onboard tank system. The U.S. project makes use of a 3.8-l displacement four-stroke, six-cylinder turbocharged engine which has accumulated over 3000 km of driving with no instances of unsafe operation. The Japanese car is based on a 1.1-l displacement, two-stroke, three cylinder direct injected engine supplied with liquid hydrogen at about 10 atm pressure and -30 to -50 C, and offers superior fuel economy, acceleration and top speed performance compared to the standard gasoline-fuelled version. A.L.W.

A82-32375
HIGH TEMPERATURE FUEL AND STEAM ELECTROLYSIS CELLS USING PROTON CONDUCTIVE SOLID ELECTROLYTES
H. IWAHARA, H. UCHIDA, and N. MAEDA (Tottori University, Tottori, Japan) Journal of Power Sources, vol. 7, Mar. 1982, p. 293-301. refs

High-temperature-type proton conductive solids are favorable materials as electrolytes for fuel cells and steam electrolysis cells for the production of hydrogen gas. An attempt has been made to construct a high temperature fuel cell and a steam electrolysis cell using an SrCeO3-based solid electrolyte, which was found to be a protonic conductor in the presence of hydrogen or water vapor. Both cells could be operated stably at 800 - 1000 C. The major limitation of the cell system was the resistance of the solid electrolytes. (Author)

A82-35077#
WILL HYDROGEN-FUELED AIRCRAFT BE SAFE
G. D. BREWER (Lockheed-California Co., Burbank, CA) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 6 p. refs
(AIAA PAPER 82-1236)

Analysis has shown that liquid hydrogen will be significantly safer than liquid methane and synjet, the other alternative fuels for aircraft. With LH2 there will be less risk of a major spill occurring in event of a crash in which passengers can survive the impact. If fuel is spilled, and assuming ignition does not occur, LH2 will not spread as far before it vaporizes, becomes buoyant, and dissipates in the atmosphere. If the spilled fuel is ignited, as will occur more than 80 percent of the time with any of the fuels, the resulting hydrogen fire will be of such short duration and will be confined to such a small area that the passenger survival rate can be expected to be much higher. (Author)

A82-37436
CONTINUOUS MICROBIAL PRODUCTION OF HYDROGEN GAS
J. D. BROSSEAU and J. E. ZAJIC (Saskatchewan Research Council, Saskatoon; Western Ontario, University, London, Canada) International Journal of Hydrogen Energy, vol. 7, no. 8, 1982, p. 623-628. refs

Techniques utilized to study microbial hydrogen gas production involved intermittent flow digesters, chemostats (continuous culture), immobilized cells and immobilized enzymes. Overall, the chemostat appears to have the greatest potential to maximize hydrogen gas productivity. Immobilized systems tended to result in lower hydrogen-producing activities which may have been due to diffusion limitation. Organic compounds, such as carbohydrates, stimulate the greatest amount of H2. (Author)

A82-37437
SOLAR HYDROGEN PRODUCTION USING TWO-STEP THERMOCHEMICAL CYCLES
E. BILGEN (Montreal, Universite, Montreal, Canada) and C. BILGEN (Exergy Research Corp., Montreal, Canada) International Journal of Hydrogen Energy, vol. 7, no. 8, 1982, p. 637-644. National Research Council refs
(Contract NRC 11SQ31025-7-1509-5; NRC 08SX31155-8-6602)

In this paper, a thermodynamic study is presented on solar hydrogen production using concentrated solar energy and two-step thermochemical cycles. After discussing the temperature availability from solar installations and temperature requirements, two-step water decomposition processes using metal/metal oxide cycles are studied in detail. Some hybrid metal/metal oxide, purely thermochemical and hybrid, metal oxide/metal sulfate cycles are also discussed. The solar high temperature heat source is briefly analyzed and interfacing problems are discussed. (Author)

A82-37444
CATALYTIC COMBUSTION OF HYDROGEN. III - ADVANTAGES AND DISADVANTAGES OF A CATALYTIC HEATER WITH HYDROGEN FUEL
M. HARUTA and H. SANO (Osaka, Government Industrial Research Institute, Ikeda, Japan) International Journal of Hydrogen Energy, vol. 7, no. 9, 1982, p. 737-740. refs

An experimental study of a catalytic heater with hydrogen fuel was conducted for comparison with a hydrocarbon-fuelled catalytic heater, in initiating temperature of combustion, adjustable heat output, and distribution of surface temperature of a catalyst. Hydrogen combustion was initiated at around room temperature even on pelletized oxides. There was no practical limitation of heat output on the lower side for hydrogen heaters, while 1.0 kcal/sq cm per hour was the lower limit for Liquified Petroleum Gas and natural gas heaters. Since hydrogen is extremely light in comparison with air and flows upwards across the catalyst body, the distribution of catalyst temperature tended to be considerably non-uniform. (Author)

A82-37445
A NOVEL BATCH-TYPE HYDROGEN TRANSMITTING SYSTEM USING METAL HYDRIDES
N. NISHIMIYA, A. SUZUKI, and S. ONO (National Chemical Laboratory for Industry, Tsukuba, Ibaraki, Japan) International Journal of Hydrogen Energy, vol. 7, no. 9, 1982, p. 741-750. refs

In the case of transporting hydrogen by means of metal hydrides, a key problem is to reduce the weight of the portable container filled with metal hydrides. The paper describes a novel batch-type hydrogen transmitting system characterized by a portable light container filled with metal hydrides, which is not pressure-proof but only mechanically durable. Hydriding is performed by setting the portable light container in a fixed pressure-proof vessel and admitting hydrogen and nitrogen inside and outside the portable container, respectively, while adjusting the pressure difference between both gases to be zero. Using this system, 2.9 cu Nm of hydrogen can be stored in 14.3 kg of the total mass of the solid constituents including 3.5 kg of Mg-10% Ni alloy. The portable container contains twice as much hydrogen per unit weight and volume as a conventional compressed gas cylinder. Due to the advanced design of this portable container, the optimum hydrogen content could be around 5 wt % based upon the total mass of the container. (Author)

N82-24689*# Department of Energy, Washington, D. C.
OVERVIEW OF THE CHEMICAL/HYDROGEN ENERGY SYSTEMS (C/HES) PROGRAM
F. GORNICK *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 141-144 Mar. 1981 Sponsored in part by JPL, Brookhaven National Lab. and DOE
Avail: NTIS HC A16/MF A01 CSCL 10A

The production, storage and transmission, and utilization of hydrogen are included. Management structure and the programmatic emphasis are summarized. Author

N82-24690*# Department of Energy, Washington, D. C.
CHEMICAL/HYDROGEN ENERGY STORAGE SYSTEMS
D. S. MILLER and A. MEZZINA *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 145-149 Mar. 1981 Sponsored in part by JPL and Brookhaven National Lab.
Avail: NTIS HC A16/MF A01 CSCL 10A

Electrochemical and thermochemical systems are reviewed. Chemical heat pumps, end-use applications and systems studies, and storage systems and materials are also discussed. N.W.

N82-24695# MPD Technology Corp., Wyckoff, N.J. Ergenics Div.
HYDRIDE CHEMICAL COMPRESSOR, PHASE 1
P. P. TURILLON, F. E. LYNCH (Hydrogen Consultants, Inc.), and R. A. NYE (Denver Research Inst.) *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 167-169 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

A proof-of-concept bench-size hydride compressor was successfully built and tested. In continuous operation this unit delivered 20.3 liters/min (43SCFH) at a pressure of 42.2 atmospheres (650 Psia). The efficiency however was lower than anticipated. The operation of this small unit revealed several important factors which influence the overall efficiency of such a hydride hydrogen compressor. The reduced efficiency of the bench scale unit was caused by mechanical design details (such as excessive amount of copper due to the electrical heating system) as well as problems with the hydriding alloy (reduced capacity at elevated temperatures and decrease in plateau pressure after 700 cycles of operation). Author

N82-24696# MPD Technology Corp., Wyckoff, N.J. Ergenics Div.
DEVELOPMENT STATUS OF A METAL HYDRIDE PROCESS FOR HYDROGEN RECOVERY
E. L. HUSTON *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 170-171 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

A new project seeking to develop and demonstrate a commercial metal hydride process for hydrogen recovery was initiated. The status of hydride separation technology is reviewed and the project milestones are summarized. Author

N82-24697# General Electric Co., Wilmington, Mass.
DEVELOPMENT STATUS OF SOLID POLYMER ELECTROLYTE WATER ELECTROLYSIS FOR LARGE SCALE HYDROGEN GENERATION
J. H. RUSSELL *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 172-174 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

Solid polymer water electrolysis technology for large scale hydrogen generation is reviewed A hydrogen generator module, capable of producing 2000 SCFH, was operated successfully for over 700 hours in the 200 kW system. Test results and further information are presented. Technology development was continued in support of improving both capital cost and conversion efficiency. Progress made in the development of the 10 sq ft active area cell included completion of the initial design, the beginning of fabrication development, and installation of new facilities for cell manufacture. Author

N82-24699# Life Systems, Inc., Cleveland, Ohio.
STATIC FEED WATER ELECTROLYSIS FOR LARGE SCALE HYDROGEN GENERATION
F. H. SCHUBERT *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 178-181 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

The static feed water electrolysis concept for aerospace application was evaluated for application in large scale hydrogen generation. The inherent potential for low cost and high performance of this alkaline electrolyte based technique was investigated. A four task program addresses the following areas: (1) definition of upper current density levels possible with the static feed concept; (2) investigation of operation with contaminated water (e.g., seawater); (3) scaleup of cell area; and (4) definition of future scale up at the cell stack and system level. The scope of each of the four program tasks is defined. E.A.K.

N82-24704# Brookhaven National Lab., Upton, N. Y.
AMMONIA AS A HYDROGEN ENERGY-STORAGE MEDIUM
G. STRICKLAND *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 201-203 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

Liquid Hydrogen (LH2), Methanol (MeOH), and Ammonia (NH3) are compared as hydrogen energy-storage media on the basis of reforming the MeOH to produce H2 and dissociating (cracking) the NH3 to release H2. The important factors in this storage concept are discussed. It is shown that, in terms of energy input for media manufacture from natural gas, hydrogen energy content of the medium, and energy cost NH3 has a wide advantage and comes the closest to matching gasoline. The tasks required in developing a safe and practical hydrogen energy-storage system based on the storage and cracking of NH3 are listed. E.A.K.

N82-24705# Billings Energy Corp., Independence, Mo.
MODIFICATION AND OPERATION OF THE HYDROGEN HOMESTEAD HYDRIDE VESSEL ENERGY STORAGE SYSTEM
R. E. BILLINGS *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 204-210 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

The safe storage of the hydrogen fuel for use in hydrogen energy was studied. The performance characteristics of bulk hydride storage is investigated. Experimental design and operating proceedings are described which include: hydrogen production, drying, purification and safety system drying, as well as the monitoring of flow, temperature, pressure data and girth measurement. E.A.K.

N82-24706# Factory Mutual Research Corp., Norwood, Mass.
HYDROGEN MICROSPHERE HAZARD EVALUATION
R. G. ZALOSH and S. N. BAJPAI *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 211-213 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

Progress on a preliminary hazard evaluation of hollow glass microspheres for hydrogen transport and storage is reported. The flammability and explosibility of representative hydrogen filled microspheres was assessed. The tests include dust cloud explosion; flame propagation; impact sensitivity; spark ignition; and autoignition furnace. The microspheres can be ignited and propagate flame either in the quiescent bulk form or as a suspended cloud. A preliminary comparison with flammability data for gaseous hydrogen and iron titanium hydride powder indicate that the autoignition temperature of hydrogen filled microspheres is comparable to that or the other forms of hydrogen, but suspended clouds of microspheres produce lower explosion pressures than hydride dust or hydrogen gas. Safety codes and government regulations pertinent to hydrogen filled microspheres are also reviewed. E.A.K.

N82-24710*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PRODUCTION COST COMPARISONS OF HYDROGEN FROM FOSSIL AND NUCLEAR FUEL AND WATER DECOMPOSITION
K. R. EKMAN *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 227-231 6 Mar. 1981 refs Sponsored in cooperation with DOE
Avail: NTIS HC A16/MF A01

The comparative costs entailed in producing hydrogen by major technologies that rely on petroleum, natural gas, coal, thermochemical cycles, and electrolysis are examined. Techniques were developed for comparing these processes by formulating the process data and economic assessments on a uniform and consistent basis. These data were normalized to permit a meaningful comparative analysis of product costs of these processes. S.L.

N82-24711*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RECENT WORK IN ADVANCED HYDROGEN PRODUCTION CONCEPTS
D. D. LAWSON *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 232 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

The hydrogen photoelectrolytic conversion activity investigated the practicability of semiconductor electrolytic devises that use solar energy to decompose water into hydrogen and oxygen in an apparent single step process. The photocatalytic decomposition of inorganic hydrogen compounds; i.e., hydrobromic and hydriodic acids using rhodium organic bridge complexes were also studied. The feasibility of direct high temperature thermal decompositions of water with diffusion processes for separation of the equilibrium mixture of hydrogen and oxygen into usable energy sources was examined. S.L.

04

FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

A82-28660
NOX FORMATION IN FLAT, LAMINAR, OPPOSED JET METHANE DIFFUSION FLAMES
W. A. HAHN and J. O. L. WENDT (Arizona, University, Tucson, AZ) In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 121-129; Comments, p. 129-131. U.S. Environmental Protection Agency refs
(Contract EPA-68-02-2631; EPA-R-803715)

Diffusion flames can play a useful role in the study of the kinetic mechanisms of pollutant formation. A laminar diffusion flame which has a number of useful attributes is the flat laminar opposed jet diffusion flame. Such a flame is established between two coaxial opposed jets, one being fuel only and the other being oxidizer only, impinging on one other. This flame is strained in its own plane, and it can be envisioned as a prototype model for laminar flamelets in turbulent diffusion flames. It is shown that the considered flame, having a given stretching rate, is one dimensional in temperature, concentration, and axial, but not radial, velocity profiles, provided the correct boundary conditions are employed for the velocities of the two incoming jets. G.R.

A82-28672
FLAME PROPAGATION IN HETEROGENEOUS MIXTURES OF FUEL DROPLETS, FUEL VAPOR AND AIR
D. R. BALLAL (GM Research Laboratories, Warren, MI) and A. H. LEFEBVRE (Purdue University, West Lafayette, IN) In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 321-328; Comments, p. 328. refs

The reported experimental investigations make use of a technique for generating flat flames in tubes which has not been applied previously to heterogeneous mixtures. The obtained results are used as a basis for the formulation of a model. The model, which is based on considerations of evaporation rates and chemical reaction rates, describes the rate of flame propagation through quiescent multidroplet mists. When evaporation times are long relative to reaction times, flame speed is enhanced by increases in gas density, fuel volatility, vapor concentration, and reduction in mean drop size. However, when chemical reaction times are limiting to the rate of flame propagation, the flame speed reverts to the normal burning velocity for the mixture. G.R.

A82-28679
EXPERIMENTAL INVESTIGATION OF METHANOL OXIDATION IN FLAMES MECHANISMS AND RATE CONSTANTS OF ELEMENTARY STEPS
J. VANDOOREN and P. J. VAN TIGGELEN (Louvain, Universite Catholique, Louvain, Belgium) In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 473-482; Comments, p. 482, 483. Fonds National de la Recherche Fondamentale Collective refs
(Contract FRFC-2,9009,76)

An experimental study of methanol combustion in laminar flames is described that provides detailed information on the principal paths of methanol consumption and on subsequent elementary reactions. Data for the rate constants involved in the oxidation of methenol are given and the combustion processes of methane and methanol are compared. The different species in the flame front were analyzed with a molecular beam sampling technique coupled with a mass spectrometer. About 70 percent of the fuel molecules are consumed by reaction with hydroxyl radical and 30 percent by reaction with the hydrogen atom. The main product is

CH_2OH or CH_3O radical. These may in turn disappear either with molecular oxygen or with other radicals. During oxidation all methanol goes through a formaldehyde stage that either reacts with radicals or disappears in a bimolecular decomposition process. C.D.

A82-28681
STABILITY LIMITS OF NATURAL GAS DIFFUSION FLAMES WITH SWIRL
R. RAWE (Munster, Fachhochschule, Munster, West Germany) and H. KREMER (Bochum, Ruhr-Universitat, Bochum; Gaswarme-Institut, Essen, West Germany) In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 667-675; Comments, p. 675-677. refs

Complete blow-off limits are investigated as a function of swirl and burner geometry, quantitative information for the calculation of flame stability limits is provided, and a model is developed for swirling flame stabilization. The dependence of blow-off velocity on the fuel to air ratio was determined for a number of burner geometries and swirl levels, and it was found that flame stability expressed in terms of the tangential velocity component increases continuously with increasing swirl strength. The study of geometrical parameters revealed that increasing the diameter of the central fuel pipe improves flame stability. The stability limits of swirling flames are correlated by means of a dimensionless Peclet number based on the maximum tangential velocity component. The stability of swirling diffusion flames depends on the location of the stoichiometric mixture within the flow field near the burner exit. C.D.

A82-28690
THE TURBULENT REACTION FIELD IN A CONCENTRIC DIFFUSION FLAME
R. GUENTHER and V. WITTMER (Karlsruhe, Universitaet, Karlsruhe, West Germany) In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 961-967. refs

The flame of a concentric double jet, the central jet consisting of natural gas and the ring jet of air, was studied in free surroundings. Time mean values, fluctuations of axial and radial velocity, nozzle fluid concentration, ionization and temperature were measured. Data for the most important correlation terms of the momentum equation were obtained. The structure of the reaction zone was studied by deriving the necessary reaction area from the respective data for a laminar flame. There is reason to believe that about 1 sq cm/s is a suitable mean diffusion coefficient for turbulent methane flames. From the radial and axial distances of ionization fronts as well as from photographs it can be inferred that combustion occurs mainly in flat burning sheets, oriented parallel to the main flow and symmetrical to the axis. C.D.

A82-28692
THE COMBUSTION OF A FUEL JET IN A STREAM OF LEAN GASEOUS FUEL-AIR MIXTURES
G. A. KARIM, I. WIERZBA, M. METWALLY, and K. MOHAN (Calgary, University, Calgary, Alberta, Canada) In: Symposium /International/ on Combustion, 18th, Waterloo, Ontario, Canada, August 17-22, 1980, Proceedings. Pittsburgh, PA, Combustion Institute, 1981, p. 977-990; Comments, p. 990, 991. Research supported by the National Research Council of Canada, Imperial Oil, Ltd., and University of Calgary. refs

The purpose is to establish the way in which the presence of a fuel vapor homogeneously dispersed in the surrounding air influences the burning characteristics of the jet flame and the corresponding flammability limits for both co-flowing and contra-flowing surrounding streams in the presence of a pilot jet diffusion flame. A wide range of jet diameters and discharge velocities is employed involving methane or hydrogen at ambient temperature and pressure. Both laminar and turbulent co-flowing streams are considered; the streams involve a range of gaseous fuel-air mixtures and include methane, hydrogen, propane and ethylene. It is shown that the presence of very small concentrations of fuel in the surroundings of the jet flame tends to increase the flame thickness and height and to considerably enhance its stabilization. It is also found that the detected flame spread lean limit of the fuels is essentially independent of the type of jet fuel and the initial jet discharge velocity. C.R.

A82-29327
DETECTION OF ENVIRONMENTAL DISTURBANCE USING COLOR AERIAL PHOTOGRAPHY AND THERMAL INFRARED IMAGERY
S. ARONOFF and G. A. ROSS (Calgary, University, Calgary, Alberta, Canada) Photogrammetric Engineering and Remote Sensing, vol. 48, Apr. 1982, p. 587-591. Research supported by the Alberta Oil Sands Environmental Research Program. refs

Characteristics of a program for satellite remote sensing for long-period environmental monitoring are examined, noting that establishing early mapping surveys of areas of concern aids in detection of stressful environmental conditions. The process is described with an example from IR and color photography of a 30,000 sq km area in the Athabasca Oil Sands, with the photography carried out from aircraft and satellite. The IR data was gathered between 8-14 microns and the photographs were taken at a 1:11,000 scale. Water-related disturbances detected included turbidity which indicated the possible presence of oil, and higher thermal emission near a tailings pond which also suggested an oil source. The presence of surface aquatic vegetation is an indicator of nutrient imbalance in a pond near a sewage pond. Finally, dead trees were observed near improperly installed culverts along new roads. M.S.K.

A82-31244
THE MT. HOOD REGION - VOLCANIC HISTORY, STRUCTURE, AND GEOTHERMAL ENERGY POTENTIAL
D. L. WILLIAMS, H. D. ACKERMANN (U.S. Geological Survey, Denver, CO), D. A. HULL (Oregon, Dept. of Geology and Mineral Industries, Portland, OR), and M. H. BEESON (Portland State University, Portland, OR) Journal of Geophysical Research, vol. 87, Apr. 10, 1982, p. 2767-2781. Research supported by the U.S. Geological Survey, U.S. Department of Energy, and Oregon Department of Geology and Mineral Industries. refs

A82-31886#
STATIONARY THERMAL IGNITION OF PARTICLE SUSPENSIONS
H. KHALIL, J. K. SHULTIS, and T. W. LESTER (Kansas State University of Agriculture and Applied Science, Manhattan, KS) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 12 p. Research supported by the Kansas State University of Agriculture and Applied Science and Alexander von Humboldt Stiftung. refs
(AIAA PAPER 82-0881)

A calculational method is presented for the stationary thermal ignition of pulverized coal suspensions, based on radiative energy transport in a heat generating medium. A diffusion-limited, Arrhenius model for heat generation is used in the description of the heterogeneous ignition and combustion of particles with the gases in which they are dispersed. The discrete ordinates method, which is used to solve numerically the radiative transfer equation, is combined with an iterative procedure to obtain both the temperature and radiation intensity distributions throughout the reacting system. Numerical examples are presented to show the variation in the critical behavior of a system in plane geometry with wall temperature and reflectivity, optical thickness of the system, particle size, optical parameters, anisotropy of the scattering, and the parameters of the heat generation model. (Author)

A82-32333
NET ENERGY ANALYSIS OF METHANOL AND ETHANOL PRODUCTION
H. PEREZ-BLANCO (Oak Ridge National Laboratory, Oak Ridge, TN) and B. HANNON (Illinois, University, Urbana, IL) Energy (UK), vol. 7, Mar. 1982, p. 267-280. refs
(Contract W-31-109-38-5154)

Methanol (MeOH) and ethanol (EtOH) are industrial alcohols that can be used as liquid fuels. They may be obtained from renewable or non-renewable feedstocks. The production processes and end uses are analyzed in order to assess the potential energy savings introduced by alcohol production from renewable instead of nonrenewable feedstock. Whereas MeOH production from wood brings about energy savings, EtOH production from corn may or may not save energy depending on the end use of the alcohol. If the alcohol is used as a motor fuel, no overall energy savings are found. The economics and total labor requirements of each process are also considered. (Author)

A82-32443* Columbia Univ., New York.
HIGH SPECTRAL RESOLUTION AIRBORNE SPECTROMETRY
W. COLLINS, S. CHANG, J. T. KUO (Columbia University, New York, NY), M. DOUMA, S. MARSHALL (Massachusetts Manufacturing Corp., Cambridge, MA), and P. MURPHY (Sanders Associates, Inc., Nashua, NH) In: Imaging spectroscopy; Proceedings of the Seminar, Los Angeles, CA, February 10, 11, 1981. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p. 22-28
(Contract JPL-955832; NSF ENG-78-24432)

An airborne spectroradiometer system developed at Columbia University has been providing new spectral data for use in remote sensing for natural resources. The system has been improved by addition of a solid state silicon detector array, and has been extended into the infrared by addition of a 64 element lead sulfide detector array. The infrared data in the 2000 to 2500 nm region especially holds large potential for mineral and oil exploration. (Author)

A82-34487
COAL TO ELECTRICITY - INTEGRATED GASIFICATION COMBINED CYCLE
J. C. CORMAN (GE Research and Development Center, Schenectady, NY) Applied Energy, vol. 10, Apr. 1982, p. 243-259. refs
(Contract EX-76-C-01-1806)

An advanced energy conversion system - the integrated gasification combined cycle (IGCC) - has been identified as an efficient and economical means of converting coal to electricity for utility application. Several demonstration projects on a near-commercial scale are approaching the construction stage. A coal conversion facility has been constructed to simulate the operational features of an IGCC. This process evaluation facility (PEF-scale) performs a dual function: (1) acquiring and processing data on the performance of the individual components - coal gasifier, gas clean up, and turbine simulator - that comprise the IGCC concept and (2) simulating the total system in an operational control mode that permits evaluation of system response to imposed load variations characteristic of utility operation. The results to date indicate that an efficient, economical IGCC can be designed so that the gasification/gas clean up plant and the power generation system operate compatibly to meet utility requirements in an environmentally acceptable manner. (Author)

A82-35293#
PLAIN-JET AIRBLAST ATOMIZATION OF ALTERNATIVE LIQUID PETROLEUM FUELS UNDER HIGH AMBIENT AIR PRESSURE CONDITIONS
A. K. JASUJA (Cranfield Institute of Technology, Cranfield, Beds., England) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 7 p. Research supported by the Ministry of Defence (Procurement Executive). refs
(ASME PAPER 82-GT-32) MEMBERS, $2.00; NONMEMBERS, $4.00

The effects that air and fuel properties have upon the spray mean drop size characteristics of a plain-jet airblast atomizer of the type employed in the gas turbine engine are investigated. The tests used kerosene, gas oil and a high-viscosity blend of gas oil in residual fuel oil, and covered a wide range of ambient air pressures. Laser light-scattering technique was employed for drop size measurements. It is concluded that the atomizer's measured mean drop size characteristics are only slightly different from those of the pre-filming type, especially when operating on low-viscosity kerosene under higher ambient air pressure. The beneficial effect of increased levels of ambient air pressure on mean drop size is shown to be much reduced in the case of high-viscosity fuels, thus making the attainment of good atomization performance on such fuels difficult. An expression is derived for correlating the obtained mean drop size data. C.D.

A82-35307*# United Technologies Research Center, East Hartford, Conn.
DEPOSIT FORMATION IN HYDROCARBON FUELS
R. ROBACK, E. J. SZETELA, and L. J. SPADACCINI (United Technologies Research Center, East Hartford, CT) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 9 p. refs
(Contract NAS3-22277)
(ASME PAPER 82-GT-49) MEMBERS, $2.00; NONMEMBERS, $4.00

The hydrocarbon fuels RP-1, commercial-grade propane, JP-7 and chemically pure propane were subjected to tests in a high pressure fuel coking apparatus in order to evaluate their thermal decomposition limits and carbon deposition rates in heated copper tubes. A fuel thermal stability parametric evaluation was conducted at 136-340 atmospheres, bulk fuel velocities of 6-30 m/sec, and tube wall temperatures of 422-811 K, and the effect of inside wall material on deposit formation was evaluated in tests using nickel-plated tubes. Results show RP-1 deposit formation at wall temperatures between 600 and 800 K, with peak deposit formation near 700 K. Substitution of deoxygenated JP-7 for RP-1 showed no improvement, and the carbon deposition rates for propane fuels were found to be higher than those of either of the kerosene fuels. Nickel plating of the tube walls significantly reduced RP-1 carbon deposition rates. O.C.

A82-35330#
CARBON FORMATION BY THE PYROLYSIS OF GAS TURBINE FUELS IN PREFLAME REGIONS OF GAS TURBINE COMBUSTORS
C. D. HURLEY (National Gas Turbine Establishment, Farnborough, Hants., England) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 7 p. refs
(ASME PAPER 82-GT-84) MEMBERS, $2.00; NONMEMBERS, $4.00

A series of experiments is carried out to investigate the formation of carbon from the pyrolysis of gas-turbine fuels, in both the gas and liquid phases, over the temperature range 573-1300 K. Two fuels are examined, a kerosene and a diesel, spanning the range of current and possible future aviation fuels. It is found that only gas-phase pyrolysis can account for the formation of carbon and that there is no difference in the carbon-forming tendencies of kerosene and diesel. The kinetics of the reaction is determined, making it possible to predict the amount of

decomposition of the fuels at temperatures up to those typical of the preflame regions of combustors. C.R.

A82-35362#
THE POTENTIAL IMPACT OF FUTURE FUELS ON SMALL GAS TURBINE ENGINES
J. A. SAINTSBURY (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada) and P. SAMPATH American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 8 p. refs (ASME PAPER 82-GT-133) MEMBERS, $2.00; NONMEMBERS, $4.00

The present investigation is based on the assumption that in the not too distant future aviation gas turbine fuels as they are known today will not be available and that it will be necessary to accept either degraded fuels or fuels derived from sources presently considered unconventional. The investigation addresses gas turbine fuels in general and their effect on combustion systems, giving particular attention to small gas turbine engine combustion systems. It is found that the impact of future fuels on aircraft gas turbine engines will vary depending on engine size and type, because of differences in fundamental design criteria, and constraints of weight, cost, and size. As a first step towards fuel conservation pending availability of viable alternate energy sources, broadened specification fuels with modest relaxations in aromatics, and freeze point will likely be in use in the near term, but fuels from alternate sources will be longer term because of the need to develop an appropriate production industry. G.R.

A82-36175#
AN ALTERNATE TEST PROCEDURE TO QUALIFY FUTURE FUELS FOR NAVY AIRCRAFT
C. A. MOSES, N. R. SEFER, and M. L. VALTIERRA (Southwest Research Institute, San Antonio, TX) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 9 p. refs
(Contract N00140-80-C-2269)
(AIAA PAPER 82-1233)

The U.S. Navy is experiencing pressures to modify the JP-5 fuel specification because of the growing shortage of high-quality crude oils from which kerosene can be simply distilled, and the increased costs of refining lesser quality crude oils to meet the current specification. A program has been initiated with the objective to study and develop a qualification procedure for future fuels. The purpose of the Alternative Test Procedure (ATP) would be to reduce the number of large-scale engine and flight tests required to develop confidence that a new fuel type will perform satisfactorily. Attention is given to future Navy aircraft fuels, the impact of future fuels on aircraft systems, aspects of hot section durability, materials compatibility, lubricity, cold day ignition, and thermal stability. It is concluded that an ATP to qualify future fuels is both necessary and feasible. G.R.

N82-22326*# Westinghouse Electric Corp., Concordville, Pa. Combustion Turbine Systems Div.
LOW NO SUB X HEAVY FUEL COMBUSTOR CONCEPT PROGRAM. PHASE 1A: COMBUSTION TECHNOLOGY GENERATION COAL GAS FUELS Final Report
T. P. SHERLOCK Feb. 1982 57 p refs
(Contract DEN3-146; DE-AI01-77ET-13111)
(NASA-CR-165614; DOE/NASA/0146-2; NAS 1.26:165614)
Avail: NTIS HC A04/MF A01 CSCL 20B

Combustion tests of two scaled burners using actual coal gas from a 25 ton/day fluidized bed coal gasifier are described. The two combustor configurations studied were a ceramic lined, staged rich/lean burner and an integral, all metal multiannual swirl burner (MASB). The tests were conducted over a range of temperature and pressures representative of current industrial combustion turbine inlet conditions. Tests on the rich lean burner were conducted at three levels of product gas heating values: 104, 197 and 254 btu/scf. Corresponding levels of NOx emissions were 5, 20 and 70 ppmv. Nitrogen was added to the fuel in the form of ammonia, and conversion efficiencies of fuel nitrogen to NOx were on the order of 4 percent to 12 percent, which is somewhat lower than the 14 percent to 18 percent conversion efficiency when src-2 liquid fuel was used. The MASB was tested only on medium btu gas (220 to 270 btu/scf), and produced approximately 80 ppmv NOx at rated engine conditions. Both burners operated similarly on actual coal gas and erbs fuel, and all heating values tested can be successfully burned in current machines. S.L.

N82-22334# Rockwell International Corp., Canoga Park, Calif.
INVESTIGATION OF COAL-GASIFICATION CATALYSIS-REACTION MECHANISMS Quarterly Technical Progress Report, Jan. - Mar. 1981
L. R. MCCOY, J. P. AMPAYA, R. C. SAUNDERS, and L. A. HEREDY Apr. 1981 19 p
(Contract DE-AC21-80MC-14592)
(DE82-003305; DOE/MC-14592/T2) Avail: NTIS HC A02/MF A01

The installation of a thermogravimetric analysis balance in a pressure enclosure capable of operation at up to 3.4 MPa with a char sample temperature of 850 C and the calibration of the balance and associated components are described. The system was placed in satisfactory operation, and essential calibration procedures were carried out. Procedures for preparation of catalyzed and noncatalyzed char from Illinois No. 6 coal obtained from the Pennsylvania State University Coal Data Bank were finalized, and char is produced on a routine basis. To expedite checkout of the balance system, experimental gasification of char with carbon dioxide was carried out. Initial gasification tests with CO2 show good reproducibility. T.M.

N82-22335# Georgia Univ., Athens. Dept. of Chemistry.
CHROMATOGRAPHIC STUDIES OF VANADIUM COMPOUNDS FROM BOSCAN CRUDE OIL
W. A. SPENCER, J. A. GALOBARDES, M. A. CURTIS, and L. B. ROGERS Aug. 1981 42 p refs
(Contract DE-AS09-76ER-00854)
(DE82-000977; DOE/ER-00854/32) Avail: NTIS HC A03/MF A01

Vanadium-non-porphyrins were fractionated. Using graphite furnace atomic absorption, the signal for vanadium was found to follow the uv absorption of the chromatogram. In addition, a simpler, faster procedure was devised to isolate a vanadium porphyrin fraction that was more nearly free from both vanadium non-porphyrins and nickel porphyrins. Pyrolysis/GC with both the flame photometric (sulfur) detector and the flame ionization detector gave evidence for a variety of sulfur species in both the porphyrin and non-porphyrin fractions. DOE

N82-22337# Burns and Roe, Inc., Woodbury, N. Y.
ASSESSMENT OF ATMOSPHERIC FLUIDIZED-BED COMBUSTION RECYCLE SYSTEMS Final Report
R. ROGALI, J. WYSOCKI, and S. KURSMAN Oct. 1981 159 p refs
(Contract EPRI PROJ. 1180-1)
(DE82-900879; EPRI-CS-2091) Avail: NTIS HC A08/MF A01

A technical and economic evaluation of AFBC power plants with recycle systems, and a comparison of these plants with AFBC power plants with carbon burnup beds (CBB) and with pulverized coal fired power plants with flue gas desulfurization systems are presented. One thousand MWe plants burning both eastern and western coals are considered. The economic analyses are based on a plant located in the east central region of the United States with a 30 year life and a 70 percent capacity factor. The eastern coal fired plants are designed to burn Illinois bitminous coal with a higher heating value of 10,100 Btu/lb and a sulfur content of 4%. The required calcium to sulfur mole ratios for the eastern plants are 3.8:1 and 2.5:1 for the AFBC/CBB and AFBC/recycle plants, respectively. The western coal fired plants are designed to burn Wyoming subbituminous coal with a higher heating value of 8,020 Btu/lb and a sulfur content of 0.48%. The required calcium to sulfur mole ratios for the western plants are 0.7:1 and 0.4:1 for the AFBC/CBB and AFBC/recycle plants, respectively. DOE

N82-22339# Institut fuer Erdoelforschung, Hanover (West Germany).
SECONDARY RECOVERY: CHANGING OF THE VISCOSITY AND COMPRESSIBILITY OF MINERAL OILS WITH DISSOLVED GAS Final Report, Jun. 1981
E. KUSS and H. KILLESREITER Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 64 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-225; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 13,40

The viscosity of selected oils, i.e. paraffinic oil, naphthene based distillate, and solvent extract, was measured with a capillary viscometer in dependence of pressure, temperature, and the mole fraction of dissolved gases N2, CO2, CH4, and C3H8. The results show decreasing viscosity with increasing gas concentration that amounts to nearly three orders of magnitude, using propane. Apart from absolute values of the viscosity, the general form of the curve for saturated isotherms in dependence of pressure is determined only by the gas and not by the oil. This facilitates estimations as with the model substances squalane and squalene. A high pressure piezometer for gas/oil solutions provides further interpretation of solubility isotherms. Author (ESA)

N82-22340# Grosskraftwerk A.G., Mannheim (West Germany).
STUDY PROJECT ON THE DESULFURIZATION OF FLUE GAS, USING THE BERGBAUFORSCHUNG (BF) PROCESS, AS PART OF THE INTEGRATED OPERATION OF A POWER PLANT WITH A CHEMICAL PLANT FOR PRODUCING SULFURIC ACID Final Report, May 1981
H. REOSNER and M. OED Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 36 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-229; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 7,60

The BF process for the desulfurization of flue gas was investigated and improved. Operation of a prototype plant and of a demonstration plant, which was added onto a coal fired power plant, is described. Without cooling the flue gas, and using modified desorption at the demonstration plant, the BF process provides SO2 rich gas as an intermediate product that can be further processed into liquefied SO2 or into H2SO4. Production of H2SO4 by integrating chemical works into the power plant complex was followed up and is found cost feasible. The SO2 liquefaction scheme was not pursued. Any treatment of the enriched gas requires scrubbing. A waste treatment method that supplies a final product with good storage characteristics, after adding calcium hydroxide, is suggested. Author (ESA)

N82-22374# Wisconsin Agri-Energy Corp., Meguon.
FEASIBILITY STUDY 20-MM GAL/YR FUEL GRADE ETHANOL FACILITY
Jun. 1981 141 p refs
(Contract DE-FG07-80RA-50392)
(DE82-002606; DOE/RA-50392/T1) Avail: NTIS HC A07/MF A01

Results of a preliminary process design and economic study of 20MM US gallons per year fuel grade anhydrous ethanol plant and an associated coal fired cogeneration facility are presented. The process was based on the use of No. 2 US yellow corn as the feedstock and a Wyoming low sulfur coal as the fuel. Distillers dried grains will be recovered as a by-product of the process. It is projected that approximately 80,000 tons of distillers dried grains will be recovered per year. The cogeneration portion will use 115,000 tons of coal a year to produce 115,000 pounds per hour of process steam while at the same time generating 13,300 kilowatts of electricity. The capital cost is estimated to be $87,504,000. Assessment of the environmental, health, safety, and socioeconomic impacts show that no significant adverse impacts are anticipated in conjunction with either facility construction or operation. Two air quality considerations require further study. DOE

N82-22375# Pace Co. Consultants and Engineers, Inc., Denver, Colo.
CORN TO ETHANOL PLANT FEASIBILITY STUDY
Feb. 1981 507 p Prepared for Grand American, Inc., Yuma, Colo.
(Contract DE-FG07-80RA-50311)
(DE82-000029; DOE/RA-50311/T1) Avail: NTIS HC A22/MF A01

The technical and economic feasibility of a corn to fuel grade ethanol plant in Colorado was assessed. The results indicate that the Grand American project is commercially viable both from an economic and technical standpoint. The results of the economic and risk analysis show a 32.7 percent rate of return based on present state and federal fuel tax exemption legislation. The plant design is based on Raphael Katzen technology which has been used for several years in existing ethanol facilities. Pace does not foresee any technical problems with the facility. Markets for the ethanol appear to be the least secure aspect of the project at this point, although demand is expected to sufficiently increase to provide ample markets. The byproduct market for the dried distillers grains appears to be supply limited. Raw materials for plant operation, including corn, power, water, and coal are readily available. DOE

N82-22378# National Grain Corp., Walnut Creek, Calif.
FEASIBILITY STUDY FOR 400,000 GAL/DAY ETHANOL PLANT AT BENICIA, CALIFORNIA, VOLUME 1
Jul. 1981 387 p Prepared in cooperation with Western Concentrates, Inc. 3 Vol.
(Contract DE-FG07-80RA-50309)
(DE82-002608; DOE/RA-50309/T1-VOL-1) Avail: NTIS HC A17/MF A01

Results of a study to investigate the feasibility of constructing a 400,000 gal/day (132 million gal/y) ethanol plant in the San Francisco Bay Area are summarized. The main objective was to determine whether and under what conditions the proposed plant could be built and operated with a prospective financial return justifying the investment. Specifically, the study set out to: define markets and prices for ethanol and all byproducts; define feedstock supplies and costs and determine utility and other raw material requirements; solve energy (fuel) supply problems and define an optimum system for generating process heat; complete a preliminary design package; define ways to minimize environmental problems and define an approach to permitting; perform and economic analysis of the plant and investigate economic sensitivities; and develop a financing and management plan for the project. DOE

N82-22380# National Grain Corp., Walnut Creek, Calif.
FEASIBILITY STUDY FOR 400,000 GAL/DAY ETHANOL PLANT AT BENICIA, CALIFORNIA. VOLUME 3. ENVIRONMENTAL REPORT
Jul. 1981 102 p refs Prepared in cooperation with Western Concentrates, Inc. 3 Vol.
(Contract DE-FG07-80RA-50309)
(DE82-002610; DOE/RA-50309/T1-VOL-3) Avail: NTIS HC A06/MF A01

The technical and economic feasibility of constructing and operating a 400,000 gallon-per-day ethanol plant in Benicia, California was studied. The environmental effects and regulatory aspects of the project are addressed. Mitigation measures which can reduce effects to acceptable levels were assessed. The likelihood and timing of obtaining the permits and approvals necessary were evaluated and problems associated with the project were identified. DOE

N82-22385# Vereinigte Elektrizitaetswerke Westfalen A.G., Dortmund (West Germany).
CONSTRUCTION OF A 15 T/HR PROTOTYPE PLANT FOR THE VEW COAL CONVERSION PROCESS Final Report, Feb. 1981
D. DEGGIM and R. KARGER Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-216; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 12,20

A 15t/hr prototype power plant was built in order to demonstrate the constructibility and operational efficiency of the VEW coal conversion process, after more than 5 years successful operation of a 1t/hr pilot plant. The prototype plant has a stone coal throughput of 15t/hr. It includes the most important units of the VEW coal conversion process, i.e., gasification unit, gas cleaning unit, and steam and power generation units. The gasification unit performs the operations: coal milling and drying, gasification and waste heat recovery, air preheating and gas cokes separation. The gas cleaning unit performs gas cooling and dust recovery, H2S-removal, salt splitting and evaporation. The gasification and gas cleaning sections are downstream, followed by a steam boiler, where the generated products are burnt. Simultaneously produced steam is processed in a steam turbine. Author (ESA)

N82-22604*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
INFLUENCE OF THE CARRYING VEHICLE IN THE AEROSPATIAL SURVEY OF NATURAL RADIOACTIVITY [INFLUENCIA DO VEICULO PORTADOR NO LEVANTAMENTO AEROSPACIAL DA RADIATIVIDADE NATURAL]
N. DEJESUSPARADA, Principal Investigator and I. M. MARTIN Sep. 1981 19 p refs In PORTUGESE Submitted for publication Sponsored by NASA ERTS
(E82-10169; NASA-CR-168592; NAS 1.26:168592; INPE-2203-PRE/019) Avail: NTIS HC A02/MF A01 CSCL 08G

The importance of the choice of the carrying vehicle in aerial surveys of natural radioactivity, particularly in the location of uraniferous regions, is discussed. The results of observations depend on the exposure time, that is, the velocity and altitude the carrying vehicle can attain. Overflights of the same region using identical instrumentation but in two different types of aircraft were performed. A detailed statistical analysis of the measurements obtained during these flights demonstrates the precision of localization achievable by this method. Author

N82-22631*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HEALTH AND SAFETY EVALUATION OF A MODIFIED TUNNEL BORER DESIGN FOR APPLICATION TO SINGLE ENTRY COAL MINE DEVELOPMENT
W. F. ZIMMERMAN 15 Feb. 1982 125 p refs
(Contract NAS7-100; DE-AI01-76ET-12548)
(NASA-CR-168807; JPL-PUB-82-12; NAS 1.26:168807; DOE/ET-12548/11) Avail: NTIS HC A06/MF A01 CSCL 08I

A health and safety analysis of a single entry coal tunnel borer system is given. The results of the health analysis indicated that while the tunnel borer design offered improvements in dust control through the use of water sprays, a higher face ventilation rule, and the application of spalling rather than the conventional grinding process, it interjected an additional mutagen and toxic compound into the environment through the use of shotcrete. The tunnel borer system easily conformed with the prescribed fatality limit, but exceeded the required limits for disabling and overall injuries. It also exhibited projected disabling and overall injury rates considerably higher than existing continuous mining injury rates. Consequently, the tunnel borer system was not considered an advanced system. R.J.F.

N82-22632*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EVALUATION OF ADAM/1 MODEL FOR ADVANCED COAL EXTRACTION CONCEPTS
G. K. DESHPANDE and M. D. GANGAL 15 Jan. 1982 26 p refs
(Contract NAS7-100; DE-AI01-76ET-12548)
(NASA-CR-168812; JPL-PUB-82-21; NAS 1.26:168812; DOE/ET-12548/12) Avail: NTIS HC A03/MF A01 CSCL 08I

Several existing computer programs for estimating life cycle cost of mining systems were evaluated. A commercially available program, ADAM/1 was found to be satisfactory in relation to the needs of the advanced coal extraction project. Two test cases were run to confirm the ability of the program to handle nonconventional mining equipment and procedures. The results were satisfactory. The model, therefore, is recommended to the project team for evaluation of their conceptual designs. R.J.F.

N82-22634# Paraho Development Corp., Grand Junction, Colo.
PARAHO OIL SHALE MODULE. CRITICAL ITEMS IDENTIFICATION, TASK 11
Oct. 1981 39 p 2 Vol.
(Contract DE-FC03-80ET-14103)
(DE82-003727; DOE/ET-14103/T2) Avail: NTIS HC A03/MF A01

A critical item in the demonstration plant is one that has a notable impact on plant performance. Generally, these items required that decisions be made throughout the course of the Phase I work to facilitate design work and preparation of estimates. The approach taken in each case represents the engineer's best judgement, based on both experience and timely evaluations. Certain critical items were identified as important enough to justify formal trade-off studies to document the alternatives considered and to justify explicitly the selected design. The critical items addressed during the Phase I work are summarized. Both the critical items and the area of performance affected are covered. A brief description of each critical item is presented including: mine and process shale areas; above ground process areas; and environmental and resource areas. DOE

N82-22638# Ruhrgas A.G., Essen (West Germany).
TESTING THE SHEARER-LOADER EDW 170/200 LN FOR THIN SEAMS IN CONNECTION WITH CHAINLESS HAULAGE Final Report
J. TEGENTHOFF and K. H. KLIMEK Bonn Bundesministerium fuer Forschung und Technologie Jan. 1982 28 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-017; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 5,50

Coal extraction by cutting was investigated. A low clearance machine design was tested. To decrease average seam thicknesses, a system able to operate in a seam aperture of approximately 1.7 m was needed. Maximum possible clearance above the machine was sought, while maintaining sufficient clearance underneath the machine for haulage. A machine height of 855 mm with underbody clearance of 475 mm was achieved. The drive performance and traction force of the winch require improvement. For better utilization of machine potential, a rotational angle should be adapted to the positioning of the drum cutters. Author (ESA)

N82-22782# Idaho National Engineering Lab., Idaho Falls.
GEOTHERMAL SOURCE POTENTIAL AND UTILIZATION FOR ALCOHOL PRODUCTION
J. C. AUSTIN Nov. 1981 71 p
(Contract DE-AC07-76ID-01570)
(DE82-003801; EGG-2138) Avail: NTIS HC A04/MF A01

A study was conducted to assess the technical and economic feasibility of using a potential geothermal source to drive a fuel grade alcohol plant. Test data from the well at the site indicated that the water temperature at approximately 8500 feet should

approach 2750 F. However, no flow data was available, and so the volume of hot water that can be expected from a well at this site is unknown. Using the available data, numerous fuel alcohol production processes and various heat utilization schemes were investigated to determine the most cost effective system for using the geothermal resource. The study found the direct application of hot water for alcohol production based on atmospheric processes using low pressure steam to be most cost effective. It was determined that a 3 million gpy alcohol plant is the largest facility that can practically be powered by the flow from one large geothermal well. DOE

N82-22783# Idaho National Engineering Lab., Idaho Falls.
POTENTIAL GEOTHERMAL ENERGY APPLICATIONS FOR IDAHO ELKS REHABILITATION HOSPITAL
J. C. AUSTIN Nov. 1981 14 p
(Contract DE-AC07-76ID-01570)
(DE82-003803; EGG-2139) Avail: NTIS HC A02/MF A01

Several potential applications of geothermal energy for the Idaho Elks Rehabilitation Hospital are outlined. A brief background on the resource and distribution system, is provided; which hospital heating systems should be considered for potential geothermal retrofit is discussed; and technical and economic feasibility are addressed. DOE

N82-22831# National Mechanical Engineering Research Inst., Pretoria (South Africa). Geomechanics Div.
COAL SEAM EXPLORATION WITH SPECIAL REGARD TO THE APPLICATION OF SEISMIC METHODS FOR THE DETECTION OF DYKES
W. N. MERTEN Jul. 1981 16 p refs
(CSIR-ME-1721; ISBN-0-7988-14810) Avail: NTIS HC A02/MF A01

The application of in seam seismic methods for coal seam exploration in connection with longwall mining is evaluated. The present exploration practice is reviewed. With the introduction of the relatively expensive high production longwall mining technique, in seam seismic methods are important to successful mining operations. The basics of relevant seismic methods are described, and a research outline is suggested. A detection of dykes is presented as a preliminary emphasis. S.L.

N82-22834# Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.
PETROGRAPHIC CHARACTERIZATION OF KENTUCKY COALS Annual Report
J. C. HOWER, J. C. FERM, J. C. COBB, E. J. TRINKLE, K. A. FRANKIE, and S. H. POE 29 Sep. 1981 19 p refs
(Contract DE-FG62-80PC-30223)
(DE82-000411; DOE/PC-30223/T2) Avail: NTIS HC A02/MF A01

The petrography of Kentucky coal was studied. Semi-inert macerals, spectral fluorescence of liptinites, and pyrite size/form/microlithotype distribution are investigated. DOE

N82-22989# Energy and Minerals Research Co., Exton, Pa.
ULTRASONICALLY ENHANCED SIZE REDUCTION OF COAL Quarterly Technical Progress Report, 25 Jun. - 25 Sep. 1981
W. B. TARPLEY, JR. and H. M. STEPHEY Oct. 1981 14 p
(Contract DE-AC22-81PC-42268)
(DE82-001601; DOE/PC-42268/T1; QTPR-1) Avail: NTIS HC A02/MF A01

The beneficial effects of ultrasonic coal comminution on a controlled laboratory scale, grinding selectivity and power requirements are discussed. The experimental work is shows that: (1) energy efficiency can be improved; (2) abrasive wear on the system will be reduced; (3) preferential fracture will reduce product size extremes; (4) and selective fracture may allow harder inclusions (ash and pyrites) to remain unaltered for easing screening. DOE

N82-23282* National Aeronautics and Space Administration. Pasadena Office, Calif.
CRUDE OIL DESULFURIZATION Patent
J. J. KALVINSKAS (California Inst. of Technology, Pasadena), G. C. HSU (California Inst. of Technology, Pasadena), and J. B. ERNEST, inventors (to NASA) (California Inst. of Technology, Pasadena) 12 Jan. 1982 4 p Filed 17 Apr. 1979 Sponsored by NASA
(NASA-CASE-NPO-14542-1; US-PATENT-4,310,049; US-PATENT-APPL-SN-030831; US-PATENT-CLASS-166-267; US-PATENT-CLASS-166-303; US-PATENT-CLASS-208-241)
Avail: US Patent and Trademark Office CSCL 07D

High sulfur crude oil is desulfurized by a low temperature (25-80 C.) chlorinolysis at ambient pressure in the absence of organic solvent or diluent but in the presence of water (water/oil=0.3) followed by a water and caustic wash to remove sulfur and chlorine containing reaction products. The process described can be practiced at a well site for the recovery of desulfurized oil used to generate steam for injection into the well for enhanced oil recovery. Author

N82-23286# Pittsburgh Energy Technology Center, Pa. Combustion Technology Div.
SMALL-SCALE COMBUSTION TESTING OF SYNTHETIC FUELS
G. A. GIBBON, J. M. EKMANN, C. M. WHITE, R. J. NAVADAUSKAS, J. I. JOUBERT, and H. L. RETCOFSKY Nov. 1981 21 p refs
(DE82-002791; DOE/PETC-TR-82/1) Avail: NTIS HC A02/MF A01

In order to assess the possible environmental impact of substituting synfuels for petroleum in utility and industrial boilers, two experimental programs have been undertaken at the Pittsburgh Energy Technology Center. First, a fully instrumented 20 hp firetube boiler capable of burning liquid fuels ranging in combustion characteristics from No. 2 to No. 6 petroleum has been installed in the Combustion Division. Second, a sampling and analytical methodology for the organic compounds present in the exhaust duct of the 20 hp boiler is being developed by the Analytical Chemistry Division. This report outlines the progress on this project to date: twenty-four successful combustion runs were completed on the 20 hp boiler, using a variety of petroleum based fuels and synfuels and a sampling protocol for organic vapors in hot exhaust gases was developed. Significant differences in the composition of the trace organics in the exhaust gases were observed as a function of the fuel being burned, but total polynuclear aromatic hydrocarbon levels are comparable for all fuels. DOE

N82-23287# Utah Univ., Salt Lake City. Biomaterials Profiling Center.
CHARACTERIZATION OF ROCKY MOUNTAIN COALS AND COAL LIQUID BY COMPUTERIZED ANALYTICAL TECHNIQUES Annual Progress Report
H. L. C. MEUZELAAR, G. R. HILL, J. H. FUTRELL, A. M. HARPER, D. J. IWAMOTO, D. L. POPE, G. S. METCALF, and J. H. TOMLINSON 1981 72 p refs
(Contract DE-FG22-80PC-30242)
(DE82-001802; DOE/PC-30242/T1; APR-1) Avail: NTIS HC A04/MF A01

Over 100 Rocky Mountain coal samples were selected and analyzed by pyrolysis mass spectrometry (MS). Computerized pattern recognition permitted the successful reduction and evaluation of the mass data base generated (over 100,000 mass peak intensities) and revealed strong clustering tendencies of pyrolysis patterns. The pyrolysis mass spectra show strong rank effects allowing complete differentiation between HVCB and HVBB coals partial differentiation both between subbituminous and HVCB samples and between HVBB ahd HVAB samples. Besides rank effects, marked differences are frequently found between samples from different coal regions, fields or even seams. The high degree of similarity observed between the pyrolysis mass spectra of samples from the same coal seam demonstrates that the combined uncertainties in sample collection, preparation and analysis are

much smaller than the chemical differences detected by the pyrolysis MS methodology. DOE

N82-23294# New Mexico Univ., Albuquerque.
PHOTOASSISTED ELECTROLYSIS APPLIED TO COAL GASIFICATION Quarterly Report, 1 Jul. - 30 Sep. 1981
S. M. PARK 1981 44 p refs
(Contract DE-AC21-81MC-16377)
(DE82-000224; DOE/MC-16377/T1) Avail: NTIS HC A03/MF A01

A literature search and study of coal oxidation mechanisms at noble metal electrodes were made. Ground work on photoassisted electrolysis of coal at the semiconductor thin film electrode was begun by preparing and characterizing n-SnO2 electrodes. It was concluded that coal is oxidized catalytically by iron(III), which in turn is reduced to iron(II). The iron(II) generated from this catalytic reaction undergoes the electrochemical oxidation, completing a cycle. The rate for this catalytic reaction is determined to be aproximately (3.0 for- 1.0) times 100,000 sec(+1) for iron(III) and 12,000 sec(+1) for Ce(IV) at 200 C, respectively. M.D.K.

N82-23326# Westinghouse Electric Corp., Madison, Pa. Synthetic Fuels Div.
WESTINGHOUSE COAL-GASIFICATION COMBINED-CYCLE PRELIMINARY PLANT EVALUATION FOR ELECTRIC-UTILITY APPLICATIONS Final Report, 30 Sep. 1979 - 30 Jun. 1981
F. GIGLIOTTI, R. M. STAVSKY, R. CHETTY, R. GARLAND, R. BENGE (Dravo Corp.), and F. KRAHULIK (Dravo Corp.) 30 Jun. 1981 133 p refs
(Contract DE-AC01-79ET-14672)
(DE82-002701; DOE/ET-14672/T1) Avail: NTIS HC A07/MF A01

An evaluation design study for electric utility application is presented. Process descriptions, cost estimates and flow diagrams are based on a plant configuration incorporating an air-blown fluidized bed gasification system, a combustion turbine system, and a reheat steam turbine system for the bottoming cycle. Scoping evaluations indicated that a plant capacity of approximately 650 megawatts electric net represents an appropriate plant size from an efficiency, as well as from a utility, point of view. Various cases are analyzed to determine the effect of plant configuration and equipment on the overall plant heat rate and annual bus bar costs. A heat rate of 8340 Btu per kilowatt hour is projected for a plant case that fully integrates the power cycle with the entire gasification process and assumes that 10000 F superheated steam is generated in the gasifier raw gas heat exchanger area. Other cases relecting less integration and lower superheated steam conditions are also presented. Heat rates and economics of conventional coal fired steam plants with stack gas scrubbers are provided for comparison. The system is projected to have efficiency and economic advantages over a conventional coal fired steam plant with stack gas scrubbers. DOE

N82-23327# California Univ., Livermore. Lawrence Livermore Lab.
PROCESS FOR UNDERGROUND GASIFICATION
R. I. ANTONOVA and E. V. KREININ Aug. 1981 18 p Transl. into ENGLISH of Belgian Patent no. 840,283 (1 Oct. 1976)
(Contract W-7405-ENG-48)
(DE82-000493; UCRL-TRANS-11720) Avail: NTIS HC A02/MF A01

An underground coal gasification process to obtain a gas having the maximum heat of combustion and to provide the capability for controlling the process is described. The underground gasification consists of a prior drainage and a gasification of a coal seam by bringing a blowing agent to the incandescent surface of the coal by means of blow holes, and vacuating the gasification products by means of a system of gas evaluation holes. The rate of the indicated gasification of the coal seam is determined as a function of natural conditions. DOE

N82-23329# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.
COAL-HYDROGASIFICATION PROCESS DEVELOPMENT, GOVERNMENT FISCAL YEAR 1981 Annual Technical Progress Report
L. P. COMBS, D. HEISTER, M. D. SCHUMAN, N. J. PATEL, M. P. GAREY, and W. T. LEE 20 Oct. 1981 170 p refs
(Contract DE-AC01-78ET-10328)
(DE82-004146; DOE/ET-10328/36; ATPR-3) Avail: NTIS HC A08/MF A01

Work performed on a coal hydrogasification process development project is described. Limited progress was made on construction of a coal feed rate integrated process development unit (IPDU) facility for conducting continuous hydrogasification tests of up to 30 days duration. A chemical kinetic model of coal particle hydropyrolysis was expanded to account for hydroconversion to a generic state of gaseous and liquid products, and this model was then used to correlate successfully carbon conversion results measured in previous flas hydropyrolysis experiments with both Kentucky No. 9 bituminous and Montana Rosebud subbituminous coals. Subsequently, that coal pyrolysis model was utilized to improve an earlier computerized model for entrained flow fluidized bed processor (FHP) coal conversion reactors. The improved model's predictions were checked against experimental conversion results and other data from 25 tests in the bituminous coal FHP data base with satisfactory agreements. Predesign process optimization and subsystem evaluations were completed. materials surveillance activities in support of the IPDU system were mainly concerned with obtaining archive specimens and data from components being fabricated, accumulating samples of alternative materials to be exposed during IPDU monitoring of key components. DOE

N82-23330# Mobay Chemical Corp., Pittsburgh, Pa.
FEASIBILITY STUDY OF MEDIUM BTU COAL GAS FOR FUEL AND FEEDSTOCK AT MOBAY'S NEW MARTINSBURG, WEST VIRGINIA PLANT
Nov. 1981 130 p
(Contract DE0-FG01-80RA-50138)
(DE82-004321; DOE/RA-50138/1) Avail: NTIS HC A07/MF A01

The use of a coal gasification process to produce medium Btu fuel gas and feedstock at Mobay's New Martinsville, West Virginia chemical plant was investigated. Using Ohio River Valley coal, the plant was designed to produce a chemical feedstock containing 93% pure H2 gas at the rate of 8,900,000 SCFD and 97.5% pure CO at a rate of 2,919,000 SCFD and a medium synthesis gas at the rate of 83,056,300 SCFD. The medium Btu synthesis gas has a heating value of 291 Btu/SCF and will be used for firing existing steam boilers. DOE

N82-23331# Miami Univ., Coral Gables, Fla. Dept. of Mechanical Engineering.
CHARACTERIZATION OF ALCOHOL/GASOLINE BLENDS AS AUTOMOTIVE FUEL: PERFORMANCE AND EMISSIONS CHARACTERISTICS
R. R. ADT, JR., K. A. CHESTER, M. HARRENSTIEN, C. N. KURUCZ, J. PAPPAS, S. RAJAN, K. T. RHEE, W. F. SPURNY, and M. SWAIN Sep. 1981 322 p refs
(Contract DE-AS05-76CS-55216)
(DE82-000124; DOE/CS-55216/T1) Avail: NTIS HC A14/MF A01

The feasibility of using alcohol blends as a motor vehicle fuel is studied. The effect of methanol blends on the performance and regulated emissions characteristics of a conventional, carburetted, multicylinder, automotive type engine and the effect of ethanol blends on the above mentioned performance and emission characteristics using the previously described engine are investigated. Denaturant effects on ethanol blend fueled engine performance and regulated emissions characteristics for the engine are also considered. The effect of methanol blends on the lean misfire limit, and a discussion concerning geometric distribution (in the conventional engine) are presented. DOE

N82-23336# Systems Science and Software, La Jolla, Calif.
COMPUTER MODELING OF COAL-GASIFICATION REACTORS. VOLUME 1: EXECUTIVE SUMMARY Final Report, Jun. 1975 - Nov. 1980
P. J. CHEN, G. P. SCHNEYER, E. W. PETERSON, T. R. BLAKE, J. L. COOK, and D. H. BROWNELL, JR. Apr. 1981 73 p refs
(Contract DE-AC21-76ET-10242)
(DE82-000768; DOE/ET-10242/T1-VOL-1; FE-1770-75-VOL-1; SSS-R-81-4814-VOL-1) Avail: NTiS HC A04/MF A01

A five-year effort to study the computer modeling of coal gasification reactors is summarized. General computer models were developed to simulate fluidized bed and entrained flow coal gasification reactors. Subsequently, they were used to simulate actual reactor environments and the resulting compared with the experimental data. An executive summary, a technical report describing the formulations and the applicatons of the computer models. User's Manuals for, respectively, the fluidized bed model and the entrained flow model are presented. DOE

N82-23337# Systems Science and Software, La Jolla, Calif.
COMPUTER MODELING OF COAL-GASIFICATION REACTORS. VOLUME 2: TECHNICAL REPORT Final Report, Jun. 1975 - Nov. 1980
G. P. SCHNEYER, E. W. PETERSON, P. J. CHEN, J. L. COOK, D. H. BROWNELL, JR., and T. R. BLAKE Apr. 1981 143 p refs
(Contract DE-AC21-76ET-10242)
(DE82-009767; DOE/ET-10242/T1-VOL-2; PE-1770-75-VOL-2; SSS-R-81-4826-VOL-2) Avail: NTIS HC A07/MF A01

The theories and numerical formulations used in developing transient, multidimensional numerical models of both fluidized bed and the entrained flow coal gasification reactors are described. The applications of two developed computer models to the simulation of actual reactor processes are discussed. Results of these computer simulations are compared with available experimental data. DOE

N82-23338# Systems Science and Software, La Jolla, Calif.
COMPUTER MODELING OF COAL-GASIFICATION REACTORS. VOLUME 3: USER'S MANUAL OF CHEMFLUB: A NUMERICAL MODEL FOR FLUIDIZED BED GASIFIERS (PLANAR AND AXISYMMTRIC VERSIONS) Final Report, Jun. 1975 - Nov. 1980
P. J. CHEN Apr. 1981 126 p refs 4 Vol.
(Contract DE-AC21-76ET-10242)
(DE82-000766; DOE/ET-10242/T1-VOL-3; FE-1770-75-VOL-3; SSS-R-81-5009-VOL-3) Avail: NTIS HC A07/MF A01

The CHEMFLUB code was designed to provide predictions of the transient, two-phase, reactive flow fields occurring in a fluidized bed coal gasification reactor. CHEMFLUB can be operated in either two dimensional Cartesian (planar) or axisymmetric geometry. The solid particle phase is treated in a Lagrangian manner in order to maintain sharp interfaces around bubbles and at the freeboard while the gas phase is treated using an Eulerian approach. A detailed chemistry model, encompassing both heterogeneous and homogeneous eactions of both combustin and gasification, is included in the model. Thus, the computer model CHEMFLUB incorporates the coupled dynamic effects of the hydrodynamic, thermodynamic, and chemical phenomena which dominate flow in most fluidized bed coal gasifiers. Detailed dicussions of the governing equations are given. A summary of the governing differential, and constitutive equations is given and a brief description of the code, including a flow chart, subroutine structure, and dimension parameters as well as a detailed input sequence are presented. DOE

N82-23339# Systems Science and Software, La Jolla, Calif.
COMPUTER MODELING OF COAL-GASIFICATION REACTORS. VOLUME 4: OPERATING MANUAL FOR EF (ENTRAINED FLOW COAL GASIFIER) COMPUTER MODEL Final Report, Jun. 1975 - Nov. 1980
D. H. BROWNELL, JR., J. L. COOK, and G. P. SCHNEYER Apr. 1981 112 p refs 4 Vol.
(Contract DE-AC21-76ET-10242; EX-77-C-01-1770)
(DE82-000765; DOE/ET-10242/T1-VOL-4; FE-1770-75-VOL-4; SSS-R-81-4920) Avail: NTIS HC A06/MF A01

The EF (Entrained Flow) computer code and three auxiliary computer codes encompass, in operational terms, the computer model of entrained flow coal gasification developed by Systems, Science and Software for the Department of Energy. The primary aspects (geometry, hydrodynamics, thermodynamics, chemistry, etc.) of the computer model are encompassed in the EF computer code which, however, uses tabular information previously generated by the three small, auxiliary computer codes; CEST, COEFTAB and PVAPOR. In this users' manual, each of the four computer programs is described in terms of the theoretical background and objective of each program. A list of the subroutines in each program and their purposes, a detailed description of the program input including an example, and a copy of real program output for the same example was presented. DOE

N82-23340# Kentucky Univ., Lexington. Economic Services Dept.
STATUS OF OCCIDENTAL PETROLEUM'S COAL-OIL-MIXTURE PROGRAM: AN INDUSTRIAL-BOILER RETROFIT
M. E. ALBERT and R. D. BESSETTA 1981 38 p refs Presented at the 20th Ann. Ky. Ind. Coal Conf., Lexington, Ky., 29 Apr. 1981
(DE82-900076; CONF-8104107-12) Avail: NTIS HC A03/MF A01

Conventional coal grinding and blending used for coal-oil-mixture preparation were investigrated. Stabilization techniques incorporated in the plant were studied. The economics for the use of COM can provide a savings sufficient to justify the retrofit for the boiler and a ROI on the facility to produce COM. The total cost difference between the cost of oil and the cost to produce COM which includes raw materials and production costs for a straight coal/oil mix with coal pulverized to 80% through 200 mesh was determined. The COM price will be based on a dollar per barrel delivered and adjusted to equivalent oil Btu's on a monthly or quarterly basis. It was concluded that COM is producible, handleable, storable and burnable. Information to minimize retrofit cost and maximize economic savings is available. Coal oil mixtures are ready to contribute dollars to the profit of each COM consuming plant. M.D.K.

N82-23616# California Univ., Livermore. Lawrence Livermore Lab.
OIL SHALE PROJECT RUN SUMMARY LARGE RETORT RUN L-4
J. H. RALEY, J. H. CAMPBELL, W. A. SANDHOLTZ, F. J. ACKERMAN, R. G. MALLON, L. L. OTT, and J. J. RONCHETTO 5 Nov. 1981 105 p refs
(Contract W-7405-ENG-48)
(DE82-003627; UCID-19238) Avail: NTIS HC A06/MF A01

A simulated MIS experiment was carried out in the 6 metric ton oil shale retort. An oil yield of 87% FA was achieved at a retorting rate of 2.8 to 3.0 m/day with a shale bed of -30 +0.001 cm particle size range and including a nearly two fold step change in grade. Temperature control was maintained by varying the steam/air ratio and injection gas rate. Oil yield, front position and retorting rate, as predicted in real time during the run from offgas data, agreed reasonably well with directly measured counterparts. Pre-run model calculations reliably predicted operating conditions for both inert gas pre-ignition and combustion retorting phases of the run. Pre-run steam logging predicted the degree of horizontal uniformity of the retorting front. Ultrasonic reflectometry, gas releasing capsules and differential pressure measurements were shown to be promising methods for temperature measurement.

Passage of the retorting front through the grade change was signalled by changes in offgas composition. DOE

N82-23617# Pacific Northwest Lab., Richland, Wash.
WESTERN OIL SHALE DEVELOPMENT: A TECHNOLOGY ASSESSMENT. VOLUME 1: MAIN REPORT Final Report
D. HESSEL and G. STRASSER Nov. 1981 360 p refs
(Contract DE-AC06-76RL-01830)
(DE82-003132; PNL-3830-VOL-1) Avail: NTIS HC A16/MF A01

The prospects of shale oil use are discussed within the context of environmental constraints, available natural and economic resources, and the characteristics of existing and emerging technology. Shale oil technologies are reviewed objectively as a means of supplying domestically produced fuels within environmental, social, economic, and legal/institutional contraints. Using available data, analyses, and experienced judgment, the major points of uncertainty regarding potential impacts of oil shale development are examined. Issues which cannot be resolved on the bases of the data, analyses, and experienced judgment currently available are identified. When appropriate and feasible, ways for the removal of existing uncertainties that stand in the way of resolving outstanding issues are suggested. DOE

N82-23618# Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
HEAT FLOW AND GEOTHERMAL ASSESSMENT OF THE ESCALANTE DESERT, SOUTHWESTERN UTAH, WITH EMPHASIS ON THE NEWCASTLE KGRA
M. D. CLEMENT and D. S. CHAPMAN Feb. 1981 126 p refs
(Contract DE-AC07-79ID-12079)
(DE82-003952; DOE/ID-12079/28) Avail: NTIS HC A07/MF A01

Twenty-five regional heat flow measurements are presented for the Escalante Desert region within the Great Basin of the western US. Heat flow excluding geothermal areas ranges from 42 to 350 mW/sq m but much of the variability may be caused by deeply circulating groundwater redistributing the regional flux. A subset of 10 sites drilled specifically to characterize the heat flow of the region yielded a mean of 100 mW/sq m with a standard cylindrical discs and rock chips of rhyolite to andesite tuffs emphasized the importance of porosity corrections to thermal conductivity measurements. A blind geothermal system southwest of Newcastle, Utah, situated within the Escalante Desert was also studied. Heat flow results from 11 local drillholes yield values between 163 and 3065 mW/sq m. The 500 mW/sq m contour encloses an area of 9.4 sq km. By integrating the anomalous flux above background over the thermal anomaly, a thermal power loss of 12.8 mW and corresponding subsurface mass discharge of 32 kg/s are calculated for this geothermal system. DOE

N82-23619# Gruy Federal, Inc., Houston, Tex.
TARGET RESERVOIRS FOR CO2 MISCIBLE FLOODING. TASK TWO: SUMMARY OF AVAILABLE RESERVOIR AND GEOLOGICAL DATA. VOLUME 1: PERMIAN BASIN GEOLOGICAL AND RESERVOIR DATA, PART 1. PERMIAN BASIN RESERVOIR SELECTION PROCEDURE, GEOLOGY, AND RESERVOIR DATA SUMMARY Final Report
L. B. COBB and J. H. GOODRICH Oct. 1981 134 p refs
Prepared in cooperation with Morgantown Energy Technology Center, W. Va.
(Contract DE-AC21-79MC-08341)
(DE82-001349; DOE/MC-08341/31-VOL-1-PT-1) Avail: NTIS HC A07/MF A01

An engineering foundation to serve as the basis for field mini- and pilot tests in both high and low oil saturation carbonate reservoirs for the purpose of extending the techology base in carbon dioxide miscible flooding is presented. Six tasks were studied and are as follows: summary of available CO2 field test data: summary of existing reservoir and geological data; selection of target reservoirs; selection of specific reservoirs for CO2 injection tests; selection of specific sites for test wells in carbonate reservoirs; and drilling and coring activities. DOE

N82-23620# Gruy Federal, Inc., Houston, Tex.
TARGET RESERVOIRS FOR CO2 MISCIBLE FLOODING. TASK TWO: SUMMARY OF AVAILABLE RESERVOIR AND GEOLOGICAL DATA. VOLUME 1: PERMIAN BASIN GEOLOGICAL AND RESERVOIR DATA; PART 3. FARMER-SAN ANDRES THROUGH NOLLEY-WOLFCAMP Final Report
L. B. COBB Oct. 1981 358 p
(Contract DE-AC21-79MC-08341)
(DE82-001347; DOE/MC-08341/31-VOL-1-PT-3) Avail: NTIS HC A16/MF A01

A summary of existing reservoir and geological data on carbonate reservoirs located in the Permian basin of west Texas and southeast New Mexico is given. The data may serve as a basis for field mini- and pilot tests in both high and low oil saturation carbonate reservoirs for the purpose of extending the technology base in carbon dioxidemisicible flooding. DOE

N82-23622# Pacific Northwest Lab., Richland, Wash. Technology Assessments Div.
WESTERN OIL SHALE DEVELOPMENT. A TECHNOLOGY ASSESSMENT Final Report
Nov. 1981 31 p
(Contract DE-AC06-76RL-01830)
(DE82-003004; PNL-3830-EXEC-SUMM) Avail: NTIS HC A03/MF A01

Shale oil technologies as a means of supplying domestically produced fuels within environmental, social, economic, and legal/institutional constraints are reviewed, using available data, analyses, and experienced judgment, to examine the major points of uncertainty regarding potential impacts of oil shale development. Issues where data and analyses are compelling or where conclusions can be reached on judgmental grounds are resolved and issues which cannot be resolved on the bases of the data, analyses, and experienced judgment currently available are specified. Ways of removing existing uncertainties that stand in the way of resolving outstanding issues are suggested. DOE

N82-23625# Western Geophysical Co. of America, Houston, Tex. Aero Service Div.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, KENORA QUADRANGLE, MINNESOTA, VOLUME 1 Final Report
Mar. 1981 87 p refs
(Contract DE-AC13-76GJ-01664)
(DE82-001029; GJBX-328-81-VOL-1) Avail: NTIS HC A05/MF A01

During the months of June through October, 1980, Aero Service Division Western Geophysical Company of America conducted an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over eleven (11) 20 x 10 NTMS quadrangles located in the states of Minnesota and Wisconsin and seven (7) 20 x 10 NTMS quadrangles in North and South Dakota. The results obtained over the Kenora map area of Minnesota are discussed. The final data are presented in four different forms: on magnetic tape; on microfiche; in graphic form as profiles and histograms: and in map form as anomaly maps, flight path maps, and computer printer maps. DOE

N82-23635# Western Geophysical Co. of America, Houston, Tex. Aero Service Div.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY. DEVIL'S LAKE QUADRANGLE, NORTH DAKOTA, VOLUME 1 Final Report
May 1981 98 p refs 2 Vol.
(Contract DE-AC13-76GJ-01664)
(DE82-004161; GJBX-354-81-VOL-1) Avail: NTIS HC A05/MF A01

During the months of June through October, 1980, an airborne high sensitivity gamma ray spectrometer and magnetometer survey was conducted over eleven 20 X 10 NTMS quadrangles located in the states of Minnesota and Wisconsin and seven 20 x 10 NTMS quadrangles in North and South Dakota. The results obtained over the Devil's Lake map area of North Dakota are

discussed. The final data are presented in four different forms: on magnetic tape; on microfiche; in graphic form as profiles and histograms; and in map form as anomaly maps, flight path maps, and computer printer maps. DOE

N82-23636# Western Geophysical Co. of America, Houston, Tex. Aero Service Div.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY. DEVIL'S LAKE QUADRANGLE, NORTH DAKOTA, VOLUME 2 Final Report
Apr. 1981 98 p 2 Vol.
(Contract DE-AC13-76GJ-01664)
(DE82-004168; GJBX-354-81-VOL-2) Avail: NTIS HC A05/MF A01

Volume 2 on airborne gamma ray spectrometer and magnetometer surveys contains the flight path map, radiometric multiple parameter stacked profiles, magnetic and ancillary parameter stacked profiles, histograms, and anomaly maps for uranium, potassium, thorium, uranium/potassium, uranium/thorium, and thorium/potassium. DOE

N82-23637# Western Geophysical Co. of America, Houston, Tex. Aero Service Div.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY. BEMIDJI QUADRANGLE, MINNESOTA, VOLUME 1 Final Report
May 1981 102 p refs 2 Vol.
(Contract DE-AC13-76GJ-01664)
(DE82-001032; GJBX-331-81-VOL-1) Avail: NTIS HC A06/MF A01

The results obtained over the Bemidji map area of Minnesota by airborne high sensitivity gamma ray spectrometer and magnetometer surveys are discussed. The final data are presented in four different forms: on magnetic tape; on microfiche; in graphic form as profiles and histograms; and in map form as anomaly maps, flight path maps, and computer printer maps. Complete data listings of both the reduced single record and the reduced averaged record data are also reported. DOE

N82-23638# Western Geophysical Co. of America, Houston, Tex. Aero Service Div.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY. BEMIDJI QUADRANGLE, MINNESOTA, VOLUME 2 Final Report
Mar. 1981 50 p 2 Vol.
(Contract DE-AC13-76GJ-01664)
(DE82-001026; GJBX-331-81-VOL-2) Avail: NTIS HC A03/MF A01

Aerial surveys of the Bemidji quadrangle, Minnesota are reported. In volume 2 the flight path map, multiparameter profiles, histograms and anomaly maps to uranium, thorium, potassium, uranium/potassium, uranium/thorium and thorium/potassium are presented. DOE

N82-23645# Geological Survey, Champaign, Ill.
ANALYSES OF NATURAL GAS IN ILLINOIS
W. F. MEENTS 1981 70 p refs Sponsored in part by the Illinois Inst. of Natural Resources
(PB82-124322; IL/SGS/IP-122) Avail: NTIS HC A04/MF A01 CSCL 08D

By the end of 1979, natural gas samples from 2,321 sources in Illinois were analyzed. Major sources of gas samples and the number of samples from those sources include: solution gas from water wells (1,402), gas wells (412), solution gas from oil wells (166); solution gas from oil-filled water supply wells (142), abandoned coal mine vents (60), gas seeps (38), landfill vents (16), and water springs (16). Several methods were used for analysis: 242 early gas samples were analyzed using the Orsat method; 47 samples were checked on a Podbielniak apparatus; the remaining 2,033 were analyzed by gas chromatography. These data are presented as a computerized data base which should be particularly valuable to geologists and geochemists interested in the occurrence and geologic history of oil and gas, or who wish to assess the potential hazards to humans of certain gaseous emanations. GRA

N82-23786# Great Plains Agricultural Council, Lincoln, Nebr. Committee on Social and Economic Implications of Energy Extraction, Conversion and Transportation
NATIONAL INTERREGIONAL COAL MODELS: PROCEEDINGS ON A WORKSHOP
J. W. GREEN, ed. Oct. 1981 275 p refs Workshop held in Bozeman, Mont., 26-27 Jul. 1979
(PB82-120932; GPAC-93; EPA-600/9-80-042) Avail: NTIS HC A12/MF A01 CSCL 10A

The Great Plains Agricultural Council's Committee on Social and Economic Implications of Energy Extraction, Conversion and Transportation (GPC-8) organized and cosponsored with the Old West Regional Commission a Workshop on National Interregional Coal Models in Bozeman, Montana on July 26-27, 1979. Detailed information on six large-scale coal models were presented at the workshop. GRA

N82-23787# National Weather Service, Salt Lake City, Utah.
PRELIMINARY ESTIMATES OF WIND POWER POTENTIAL AT THE NEVADA TEST SITE
H. G. BOOTH Jul. 1981 19 p refs Prepared in cooperation with National Weather Service, Las Vegas, Nev.
(PB82-127036; NOAA-TM-NWS-WR-166) Avail: NTIS HC A02/MF A01 CSCL 10A

An assessment of the potential for the useful conversion of wind power to electrical power is given for a Nevada test site. Annual wind power availability was estimated to be sufficient. The percentage of low wind hours was found to be high, and the persistence of favorably strong winds for periods of several days at a time was low. There was a pronounced diurnal cycle in wind power availability. It is concluded that baseload electrical power requirements would require alternate energy sources. Cost effectiveness of this configuration would have to be determined. R.J.F.

N82-23830# Oklahoma Univ., Norman.
SOURCE ROCK GEOCHEMISTRY AND LIQUID AND SOLID PETROLEUM OCCURRENCES OF THE OUACHITA MOUNTAINS, OKLAHOMA Ph.D. Thesis
J. A. CURIALE 1981 305 p
Avail: Univ. Microfilms Order No. 8129427

Crude oils, solid bitumens and potential oil source rocks of the frontal and central Ouachita Mountains of southeastern Oklahoma are examined. The organic matter in each of these materials is characterized, and oils are correlated to potential source rocks in the Ouachita Mountains. Four Ouachita Mountain oils and seven solid bitumens (grahamite and impsonite) are analyzed. The oils are paraffinic and range from 31.8 to 43.1 API gravity. The oils are thermally mature and generally unaltered. All four oils are commonly sourced, by n-alkane, sterane and hopane distributions, stable isotope ratios, infrared spectra and vanadium/nickel ratios. A common source for the solid bitumens is also suggested by isotope ratios and pyrolyzate characteristics. An origin due to crude oil biodegradation is suggested for these solids, based on carbon isotope ratios, elemental analyses, and sterane distributions of the solid bitumen pyrolyzates. Dissert. Abstr.

N82-23835# Idaho National Engineering Lab., Idaho Falls.
RAFT RIVER GEOSCIENCE CASE STUDY: APPENDIXES
M. R. DOLENC, L. C. HULL, S. A. MIZELL, B. F. RUSSELL, P. A. SKIBA, J. A. STRAWN, J. A. TULLIS, and R. GARBER, ed. Nov. 1981 155 p refs 2 Vol.
(Contract DE-AC07-76ID-01570)
(DE82-003553; EGG-2125-VOL-2) Avail: NTIS HC A08/MF A01

The lithology, x-ray analysis, cores, and well construction data are presented. Borehole geophysical logs, chemical analyses from wells at the Raft River geothermal site, and a bibliography are included. T.M.

N82-23837# Sandia Labs., Albuquerque, N. Mex. In Situ Technologies Div.
EFFECT OF PULSE LOADS ON DYNAMIC ROCK FRACTURE
E. P. CHEN Oct. 1981 27 p refs
(Contract DE-AC04-76DP-00789)
(DE82-002311; SAND-81-1942) Avail: NTIS HC A03/MF A01

An analytical model was developed which is capable of predicting the fracture pattern in the rock surrounding a wellbore upon which a dynamic loading pulse is applied. The development of the model followed the principle of elastodynamic fracture mechanics. Specifically, inherent cracks are assumed to exist around the edge of the wellbore. Depending on the pulse shape, these cracks are activated to form various fracture patterns. The criterion for initiation of crack growth is determined by the magnitude of the dynamic stress intensity factor associated with the crack. The finite element code HONDO was used to calculate the dynamic stress intensity factors. Analytical predictions were correlated with field experimental data and good agreements were found. DOE

N82-24123# California Univ., Berkeley.
THERMODYNAMICS OF GEOTHERMAL FLUIDS Ph.D. Thesis
P. S. Z. ROGERS 1981 249 p
Avail: Univ. Microfilms Order No. 8200253

A model to predict the thermodynamic properties of geothermal brines, based on a minimum amount of experimental data on a few key systems, was tested. Volumetric properties of aqueous sodium chloride, taken from the literature, are represented by a parametric equation over the range 0 C to 300 C and 1 bar to 1 kbar. Density measurements at 20 bar needed to complete the volumetric description also are presented. The pressure dependence of activity and thermal properties, derived from the volumetric equation, were used to complete an equation of state for sodium chloride solutions. A flow calorimeter used to obtain heat capacity data at high temperatures and pressures is described. Heat capacity measurements from 30 C to 200 C and 1 bar to 200 bar are used to derive values for the activity coefficient and other thermodynamic properties of sodium sulfate solutions as a function of temperature. Literature data on the solubility of gypsum in mixed electrolyte solutions was used to evaluate model parameters for calculating gypsum solubility in seawater and natural brines. Predictions of strontium and barium sulfate solubility in seawater are also given. Dissert. Abstr.

N82-24350# International Atomic Energy Agency, Vienna (Austria).
MOESSBAUER SPECTROSCOPY STUDY ON THE EFFECT OF INFRARED AND GAMMA RADIATION ON THE STRUCTURE OF MINERALS. PART OF COORDINATED PROGRAMME ON DEVELOPMENT OF METHODS FOR APPLICATION OF MOESSBAUER SPECTROSCOPY IN MINERALOGY, SOIL SCIENCES AND THE STUDY OF CERAMICS Final Report, 1 Apr. 1978 - 30 Sep. 1981
H. POLLAK (National Univ. of Zaire) Aug. 1981 3 p
(DE81-700780; IAEA-R-2174-F) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries

A number of fundamental and applied problems were studied by Moessbauer spectroscopy. The observation of Moessbauer spectra in iron silicate deerite with respect to the structure of this mineral was interpreted by charge transfer between iron ions, and correlated with thermally activated electron delocalisation. The studies of local coals showed the suitability of Moessbauer spectroscopy in control of the desulfurization process. A simple method to use Moessbauer measurement to determine the obstructions in water pipes was developed. DOE

N82-24351# Committee on Energy and Commerce (U. S. House).
FOSSIL AND SYNTHETIC FUELS MISCELLANEOUS, PART 1
Washington GPO 1981 213 p refs Hearings on H.R. 2166 before the Subcomm. on Fossil and Synthetic Fuels of the Comm. on Energy and Com., 97th Congr., 1st Sess., 26 Feb. 1981
(GPO-84-010) Avail: Subcommittee on Fossil and Synthetic Fuels

The limited antitrust defense available under the Energy Policy and Conservation Act to domestic oil companies participating in an international energy program is discussed. The extension of this antitrust protection beyond March 15, 1982 is considered. An authorization request concerning safety measures to be taken with regard to liquefied natural gas pipelines is discussed. Also discussed is gasohol usage, particularly in government owned motor vehicles. R.J.F.

N82-24352# Committee on Science and Technology (U. S. House).
DIRECT COMBUSTION OF COAL
Washington GPO 1982 128 p refs Hearing before the Subcomm. on Energy Develop. and Appl. of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., No. 69, 10 Dec. 1981
(GPO-89-628) Avail: Subcommittee on Energy Development and Applications

The utilization of coal through direct combustion is discussed. The environmental problems associated with coal use and the work being done to alleviate a number of the problems are discussed. Fluidized bed processors are described. Future domestic energy policy is discussed. R.J.F.

N82-24354# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
A FIELD MONITOR FOR THE STABILITY AND CLEANLINESS OF DISTILLATE FUEL Interim Report, Oct. 1978 - Sep. 1981
S. R. WESTBROOK, L. L. STAVICHA, J. G. BARBEE, and J. V. MENGENHAUSER (Army Mobility Equipment Research and Development Command, Ft. Belvoir, Va.) Dec. 1981 56 p refs
(Contract DAAK70-78-C-0001; DAAK70-80-C-0001; DA PROJ. 1L7-62733-AH-20)
(AD-A110694; AFLRL-137) Avail: NTIS HC A04/MF A01 CSCL 14B

This report details the development of a portable device to measure the cleanliness and stability of diesel fuels in both bulk and vehicle fuel cell storage. Both an initial laboratory prototype and a portable field unit are discussed. The monitor evaluates the cleanliness of the fuel by first filtering the fuel and then determining the amount of particulates on the filters using a contaminated filter measuring device. The filters are rated by measuring the amount of light which passes through the filters to estimate the amount of particulates based on a calibration chart. A measure of the stability of the fuel is obtained by aging a sample of the fuel at 150 C for 1.5 hours and determining the amount of sediment formed. Improvements to the diesel fuel quality monitor have been identified and are being investigated. A field test program to demonstrate monitor utility/effectiveness is planned for initiation in late 1981. In addition, a commercially available portable unit to measure particulate contamination is described and compared to the Army field test unit. GRA

N82-24355# Southwest Research Inst., San Antonio, Tex. Energy Systems Research Div.
IMPACT STUDY OF SYNTHETIC AND ALTERNATIVE FUEL USAGE IN ARMY AIRCRAFT PROPULSION SYSTEMS Final Report, Oct. 1980 - Jun. 1981
C. A. MOSES and M. I. VALTIERRA Jul. 1981 166 p refs Sponsored in part by the Army Mobility Research and Development Command
(Contract N00140-80-C-2269)
(AD-A111046; SWRI-MED134) Avail: NTIS HC A08/MF A01 CSCL 21D

The U.S. Army is concerned about the quality of future aircraft fuels and their compatibility with current engines and aircraft fuel systems. This impact study of synthetic and alternate fuel usage on Army aircraft propulsion and fuel systems addresses four technical areas: (1) The fuel scenario for Army aviation gas turbine fuels; (2) The effects of initial properties or the performance and durability of engine and fuel system components; (3) The identification of engines and fuel system components used in Army aircraft and their interface with the fuel; and (4) A review of qualification and certification procedures. Author (GRA)

N82-24525*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LANDSAT REMOTE SENSING: OBSERVATIONS OF AN APPALACHIAN MOUNTAINTOP SURFACE COAL MINING AND RECLAMATION OPERATION
Oct. 1979 7 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 Original contains color illustrations ERTS
(E82-10247; NASA-TM-84194; NAS 1.15:84194) Avail: NTIS HC A02/MF A01 CSCL 08I

The potential benefits of using LANDSAT remote sensing data by state agencies as an aide in monitoring surface coal mining operations are reviewed. A mountaintop surface mine in eastern Kentucky was surveyed over a 5 year period using satellite multispectral scanner data that were classified by computer analyses. The analyses were guided by aerial photography and by ground surveys of the surface mines procured in 1976. The application of the LANDSAT data indicates that: (1) computer classification of the various landcover categories provides information for monitoring the progress of surface mining and reclamation operations; (2) successive yearly changes in barren and revegetated areas can be qualitatively assessed for surface mines of 100 acres or more of disrupted area; (3) barren areas consisting of limestone and shale mixtures may be recognized, and revegetated areas in various stages of growth may be identified against the hilly forest background. E.A.K.

N82-24566*# Mississippi State Univ., Mississippi State. Remote Sensing Center.
APPLICATION OF REMOTE SENSING TO STATE AND REGIONAL PROBLEMS Semiannual Progress Report, 1 May - 31 Oct. 1981
W. F. MILLER, J. R. CLARK, J. L. SOLOMON, B. DUFFY, K. MINCHEW, and L. H. WRIGHT, Principal Investigator 1 Nov. 1981 89 p refs ERTS
(Contract NGL-25-001-054)
(E82-10288; NASA-CR-168857; NAS 1.26:168857; SAPR-16)
Avail: NTIS HC A05/MF A01 CSCL 06B

The objectives, accomplishments, and future plans of several LANDSAT applications projects in Mississippi are discussed. The applications include land use planning in Lowandes County, strip mine inventory and reclamation, white tailed deer habitat evaluation, data analysis support systems, discrimination of forest habitats in potential lignite areas, changes in gravel operations, and determination of freshwater wetlands for inventory and monitoring. In addition, a conceptual design for a LANDSAT based information system is discussed. M.G.

N82-24649*# Parsons (Ralph M.) Co., Pasadena, Calif.
FUEL QUALITY PROCESSING STUDY, VOLUME 1 Final Report
J. B. OHARA, A. BELA, N. E. JENTZ, H. T. SYVERSON, H. W. KLUMPE, R. E. KESSLER, H. T. KOTZOT, and B. L. LORAN Apr. 1981 203 p refs 2 Vol.
(Contract DEN3-183; DE-AI01-77ET-13111)
(NASA-CR-165327-VOL-1; DOE/NASA/0183-1; NAS 1.26:165327-VOL-1) Avail: NTIS HC A10/MF A01 CSCL 21D

A fuel quality processing study to provide a data base for an intelligent tradeoff between advanced turbine technology and liquid fuel quality, and also, to guide the development of specifications of future synthetic fuels anticipated for use in the time period 1985 to 2000 is given. Four technical performance tests are discussed: on-site pretreating, existing refineries to upgrade fuels, new refineries to upgrade fuels, and data evaluation. The base case refinery is a modern Midwest refinery processing 200,000 BPD of a 60/40 domestic/import petroleum crude mix. The synthetic crudes used for upgrading to marketable products and turbine fuel are shale oil and coal liquids. Of these syncrudes, 50,000 BPD are processed in the existing petroleum refinery, requiring additional process units and reducing petroleum feed, and in a new refinery designed for processing each syncrude to produce gasoline, distillate fuels, resid fuels, and turbine fuel, JPGs and coke. An extensive collection of synfuel properties and upgrading data was prepared for the application of a linear program model to investigate the most economical production slate meeting petroleum product specifications and turbine fuels of various quality grades. Technical and economic projections were developed for 36 scenarios, based on 4 different crude feeds to either modified existing or new refineries operated in 2 different modes to produce 7 differing grades of turbine fuels. A required product selling price of turbine fuel for each processing route was calculated. Procedures and projected economics were developed for on-site treatment of turbine fuel to meet limitations of impurities and emission of pollutants. R.J.F.

N82-24650*# Parsons (Ralph M.) Co., Pasadena, Calif.
FUEL QUALITY/PROCESSING STUDY. VOLUME 2: APPENDIX. TASK 1 LITERATURE SURVEY Final Report
J. B. OHARA, A. BELA, N. E. JENTZ, H. W. KLUMPE, H. E. KESSLER, H. T. KOTZOT, and B. L. LORAN Apr. 1981 274 p refs 2 Vol.
(Contract DEN3-183; DE-AI01-77ET-13111)
(NASA-CR-165327-VOL-2; DOE/NASA/0183-1; NAS 1.26:165327-VOL-2) Avail: NTIS HC A12/MF A01 CSCL 21D

The results of a literature survey of fuel processing and fuel quality are given. Liquid synfuels produced from coal and oil shale are discussed. Gas turbine fuel property specifications are discussed. On-site fuel pretreatment and emissions from stationary gas turbines are discussed. Numerous data tables and abstracts are given. R.J.F.

N82-24732# Oak Ridge National Lab., Tenn. Fossil Energy Materials Office.
FOSSIL-ENERGY MATERIALS PROGRAM Quarterly Progress Report, period ending 30 Jun. 1981
Sep. 1981 418 p refs
(Contract W-7405-ENG-26)
(DE82-001057; ORNL/FMP-81/3) Avail: NTIS HC A18/MF A01

Research and development on materials for fossil energy applications with a focus on the longer term and generic needs of the various fossil fuel technologies is reported. The program includes research aimed toward a better understanding of materials behavior in fossil energy enviroments and the development of new materials capable of substantial enhancement of plant operations and reliability. Projects related to a particular fossil energy technology are described. The various projects associated with that technology are outlined. The fossil energy materials program quarterly progress reports series as a dissemination of information which is developed on the program. DOE

N82-24775# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.

ASSESSMENT OF PRECISE SURFACE-GRAVITY MEASUREMENTS FOR MONITORING THE RESPONSE OF A GEOTHERMAL RESERVOIR TO EXPLOITATION

R. B. GRANNELL, J. H. WHITCOMB, P. S. ARONSTAM, and R. C. CLOVER Jun. 1981 112 p refs Prepared in cooperation with California State Univ., Long Beach and Colorado Univ., Boulder

(Contract W-7405-ENG-48)

(DE82-003904; LBL-12910; GSRMP-11) Avail: NTIS HC A06/MF A01

Recommendations for carrying out surveys which achieve 15, 10 and 5 microgal precisions are presented. Twenty geothermal areas in the western United States which might be suitable for precise repetitive gravity monitoring were evaluated. The evaluation criteria included capability for subsidence on a geological basis, estimated electrical production, environmental impact, and anticipation of production in the near future. It is felt that the most promising areas in order of priority are: (1) the Salton Sea field, California; (2) Valles Caldera, New Mexico; (3) the Geysers-Clear Lake; and (4) Westmorland, California; (5) Roosevelt Hot Springs, Utah; and (6) Heber, Brawley, and Long Valley, California. DOE

N82-25394*# National Aeronautics and Space Administration. Pasadena Office, Calif.

AUTOCATALYTIC COAL LIQUEFACTION PROCESS Patent Application

S. A. QADER, Principal Investigator (JPL, California Inst. of Technology, Pasadena) 3 Jan. 1980 32 p Sponsored by NASA

(NASA-CASE-NPO-14876-2; US-PATENT-APPL-SN-285194)

Avail: NTIS HC A03/MF A01 CSCL 21D

An improved process for liquefying coal in which coal minerals at high content are utilized as hydrocracking catalysts id described. A slurry of 10 to 60% by weight of coal in a recycled liquefied coal product containing 15 to 30% by weight of coal minerals is pressurized with excess hydrogen to a pressure of 2,000 to 4,000 psi and heated to a temperature of 450 to 550 degrees C. The coal minerals autocatalytically convert coal solids to a low viscosity liquid product and to a gas product in high yields while reducing oxygen, nitrogen, and sulfur content of the coal product as compared to other coal liquefaction processes under development. NASA

N82-25396# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

AN ECONOMIC MODEL OF FUTURE COAL/DENSIFIED REFUSE-DERIVED FUEL USE AT WRIGHT-PATTERSON AFB, OHIO M.S. Thesis

R. G. FEDORS Sep. 1981 184 p refs

(AD-A111376; AFIT-LSSR-97-81) Avail: NTIS HC A09/MF A01 CSCL 13A

A thirty-month evaluation/demonstration of densified refuse-derived fuel (dRDF) as a stoker boiler fuel in military heating plants was performed. The impact on plant operating expenses of burning coal dRDF mixtures at that particular base is examined. The figures for comparison were generated by a simulation model of the base heating system and environment. Projected yearly operating expenses were accumulated in the model and returned to present values for various fuel ratios, inflation rates, and discount factors. Under the assumptions made within the model, coal alone will remain less expensive to use than a mixture of dRDF until a local source of dRDF becomes available. J.D.

N82-25399# General Technology Applications, Inc., Arlington, Va.

INVESTIGATION OF THE APPLICATION OF A CRYOGENIC BLENDING PROCESS TO PRODUCE ANTIMISTING DIESEL FUELS Final Report

A. F. HADERMANN, P. WATERS, J. C. TRIPPE, and W. WEITZEN 15 Jan. 1982 65 p refs

(Contract DAAK70-81-C-0134)

(AD-A110917; GTA-A-001) Avail: NTIS HC A04/MF A01 CSCL 21D

Fire-resistant fuels have been investigated by the United States Army as a means of reducing the risk of fire in land combat vehicles and certain aircraft. One approach has been the use of high-molecular-weight polymer additives for suppression of mist formations. The polymers which are effective in mist suppression are very difficult to dissolve in fuel. A newly discovered process for dissolving high-molecular-weight polymers is investigated to determine its applicability to the preparation of mist suppression fuels. The conclusions area that certain high-molecular-weight polymers which show strong mist suppression behavior can be dissolved rapidly in diesel fuel and that the new dissolving process appears to be adaptable to field use. Author (GRA)

N82-25616# Los Alamos Scientific Lab., N. Mex.

EVALUATION OF THE SECOND HOT DRY ROCK GEOTHERMAL ENERGY RESERVOIR: RESULTS OF PHASE 1, RUN SEGMENT 5

G. A. ZYVOLOSKI, R. L. AAMODT, R. G. AGUILAR, D. A. COUNCE, H. N. FISHER, T. A. GRANT (Zia Co., Los Alamos, N.Mex.), C. O. GRIGSBY, R. H. HENDRON, C. E. HOLLEY, JR., and R. G. LAWSON Sep. 1981 99 p refs

(Contract W-7405-ENG-36)

(DE82-002520; LA-8940-HDR) Avail: NTIS HC A05/MF A01

The results of a long term (286 day) flow test of a second hot dry rock reservoir are presented. This second reservoir was created by fracturing an interval of granitic rock located at a depth of 2.93 km (9620 ft) in the same wellbore pair used in the creation of the first, smaller reservoir. The new fracture system has a vertical extent of at least 320 m (1050 ft), suggesting that the combined heat transfer area of the old and new fracture systems is much greater than that of the old system. The virgin rock temperature at the bottom of the deeper interval was 1970 C (3860 F). Downhole measurements of the water temperature at the reservoir outlet, as well as temperatures inferred from geothermometry, showed that the thermal drawdown of the reservoir was about 80 C, and preliminary estimates indicate that the minimum effective heat transfer area of the new reservoir is 45,000 sq m (480,000 sq ft), which is six times larger than the first reservoir. DOE

N82-25617# Los Alamos Scientific Lab., N. Mex.

INVESTIGATIONS OF LOW-TEMPERATURE GEOTHERMAL POTENTIAL IN NEW YORK STATE

D. S. HODGE, R. DERITO (State Univ. of New York, Buffalo), K. MIFIKER (State Univ. of New York, Buffalo), P. MORGAN, and C. A. SWANBERG Sep. 1981 76 p refs

(Contract W-7405-ENG-36)

(DE82-002517; LA-8960-MS) Avail: NTIS HC A05/MF A01

Temperature gradient map and published heat flow data indicate a possible potential for a geothermal resource in western and central New York State. An analysis of bottom hole temperature data for New York State confirm the existence of three positive gradient anomalies: the East Aurora, Cayuga, and Elmira anomalies, with gradients as high as 320 C/km, 360 C/km, and 360 C/km, respectively. Ground waters from two of these anomalies are enriched in silica relative to surrounding areas. Heat flows based on silica geothermometry are 50 to 70 sq mWm (+2) for the anomalies and 41.4 sq mWm (+2) for bordering regional flux. A correlation between Bougner gravity anomalies and the temperature gradient map suggests that the geothermal anomalies may occur above radioactive granites in the basement. DOE

N82-25620# High Life Helicopters, Inc., Puyallup, Wash.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, TORONTO QUADRANGLE NEW YORK, VOLUME 2A Final Report
1981 90 p refs Prepared in cooperation with QEB, Inc. 3 Vol.
(Contract DE-AC13-79GJ-01692)
(DE81-027158; GJBX-211-81-VOL-2A) Avail: NTIS HC A05/MF A01

No uranium anomalies meet the minimum statistical requirements as defined and no anomaly map is presented. Potassium (%K), equivalent Uranium (ppm eU), equivalent Thorium (ppm eTh), eU/eTh, eU/K, eTh/K, and magnetic pseudo-contour maps are presented. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are also presented. All maps and profiles were prepared on a scale of 1:250,000, but were reduced to 1:500,000 for presentation. DOE

N82-25621# High Life Helicopters, Inc., Puyallup, Wash.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, KINGSTON QUADRANGLE NEW YORK, VOLUME 2C Final Report
1981 64 p refs Prepared in cooperation with QEB, Inc. 3 Vol.
(Contract DE-AC13-79CJ-01692)
(DE81-027161; GJBX-211-81-VOL-2C) Avail: NTIS HC A04/MF A01

No uranium anomalies meet the minimum statistical requirements as defined. No Uranium Anomaly Map is given. Potassium (%K), equivalent Uranium (ppm eU), equivalent Thorium (ppm eTh), eU/eTh, eU/K, eTh/K, and magnetic pseudo-contour maps are presented. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are also presented. All maps and profiles were prepared on a scale of 1:250,000, but were reduced to 1:500,000 for presentation. DOE

N82-25622# High Life Helicopters, Inc., Puyallup, Wash.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, ROCHESTER QUADRANGLE NEW YORK, VOLUME 2D Final Report
1981 143 p refs Prepared in cooperation with QEB, Inc. 3 Vol.
(Contract DE-AC13-79GJ-01692)
(DE81-027156; GJBX-211-81-VOL-2D) Avail: NTIS HC A07/MF A01

One uranium anomaly met the minimum statistical requirements as defined. This anomaly is listed and is shown on the Uranium Anomaly Interpretation Map. Potassium (%K), equivalent Uranium (ppm eU), equivalent Thorium (ppm eTh), eU/eTh, eU/K, eTh/K, and magnetic pseudo-contour maps are also presented. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are presented. All maps and profiles were prepared on a scale of 1:250,000, but were reduced to 1:500,000 for presentation. Anomaly number 1 is over an area underlain by shale and dolomite of the upper Silurian Camillus and Syracuse formations (Scy). DOE

N82-25624# Los Alamos Scientific Lab., N. Mex.
METHANE HYDRATE RESOURCE ASSESSMENT PROGRAM Progress Report, Jul. - Sep. 1980
B. L. BARRACLOUGH, P. L. MCGUIRE, and S. P. KOCZAN Sep. 1981 36 p refs
(Contract W-7405-ENG-36)
(DE82-002478; LA-8933-PR; QR-2) Avail: NTIS HC A03/MF A01

Progress on a program to study the nature, occurrence, and resource potential of methane (natural gas) hydrate is described. Planning for an experimental field program is continuing and a range of feasible field efforts is outlined. A variety of methods and equipment suitable for hydrate coring work was identified. A new cryogenic wireline coring system, which is intended for use with very cold drilling fluids, was developed for retrieving hydrated samples from subsurface strata, and details are presented. A unique concept for forming hydrate in the pore space of various sediments is outlined, and details of the proposed experimental apparatus are given. Continuing studies of hydrate gas production by thermal stimulation methods indicate that steam injection is not practical. Two reservoir computer models were developed, which are believed to bracket probably hydrate gas production rates. These models are discussed and the preliminary results of reservoir parameter studies are presented. DOE

N82-25627# Geological Survey, Helena, Mont.
MEAN ANNUAL STREAMFLOW OF SELECTED DRAINAGE BASINS IN THE COAL AREA OF SOUTHEASTERN MONTANA Final Water Resources Investigations
R. F. FERREIRA Oct. 1981 28 p refs Prepared in cooperation with EPA
(PB82-137696; USGS/WRD/WRI-81/097; USGS/WRI-81-61)
Avail: NTIS HC A03/MF A01 CSCL 08H

Streamflow characteristics of drainage basins within the Fort Union coal region of southeastern Montana were estimated to provide premining data for evaluating the future effects of mining on the environment. Estimated annual mean streamflow at 22 data collection stations ranged from 0 to 887 cubic feet per second. These estimates are based on miscellaneous streamflow records at each station and continuous streamflow records from other stations in the study area. Estimated mean annual streamflow for a 10 year period ranged from 0 to 572 cubic feet per second. Many of the drainage basins had a mean annual runoff of less than 0.60 inch; the maximum observed mean annual runoff was 4.45 inches. GRA

N82-25635*# Detroit Diesel Allison, Indianapolis, Ind.
LOW NOX HEAVY FUEL COMBUSTOR CONCEPT PROGRAM Final Report
A. S. NOVICK and D. L. TROTH Oct. 1981 206 p refs
(Contract DEN3-148; DE-AI01-77ET-13111)
(NASA-CR-165367; NAS 1.26:165367; DDA-EDR-10594; DOE/NASA/0148-1) Avail: NTIS HC A10/MF A01 CSCL 10B

The development of the technology required to operate an industrial gas turbine combustion system on minimally processed, heavy petroleum or residual fuels having high levels of fuel-bound nitrogen (FBN) while producing acceptable levels of exhaust emissions is discussed. Three combustor concepts were designed and fabricated. Three fuels were supplied for the combustor test demonstrations: a typical middle distillate fuel, a heavy residual fuel, and a synthetic coal-derived fuel. The primary concept was an air staged, variable-geometry combustor designed to produce low emissions from fuels having high levels of FBN. This combustor used a long residence time, fuel-rich primary combustion zone followed by a quick-quench air mixer to rapidly dilute the fuel rich products for the fuel-lean final burnout of the fuel. This combustor, called the rich quench lean (RQL) combustor, was extensively tested using each fuel over the entire power range of the model 570 K engine. Also, a series of parameteric tests was conducted to determine the combustor's sensitivity to rich-zone equivalence ratio, lean-zone equivalence ratio, rich-zone residence time, and overall system pressure drop. Minimum nitrogen oxide emissions were measured at 50 to 55 ppmv at maximum continuous power for all three fuels. Smoke was less than a 10 SAE smoke number. M.G.

N82-25726# Los Alamos Scientific Lab., N. Mex.
EXPLOSIVELY PRODUCED FRACTURE OF OIL SHALE Progress Report, Jul. - Sep. 1980
Oct. 1981 38 p
(Contract W-7405-ENG-36)
(DE82-004182; LA-9045-PR) Avail: NTIS HC A03/MF A01

Explosive cratering experiments were conducted as a part of the research effort to study the explosively produced fracture of oil shale. They were designed to identify and analyze the major factors involved in the fracturing of oil shale, to provide data for the verification of the computer models, and ultimately to lead to

the design of a rubble bed for in situ retorting oil shale. The rubble excavated from eight cratering experiments was separated and the volumes of rubble in each screened size category are presented. Also presented are the data from the detailed investigation of the joint/fracture attitudes (strikes and dips) within a crater interior after excavation. The data were tabulated and plotted to allow future comparisons and analyses pertinent to similar experiments. A brief discussion of the experiment site and the graphical representation of the data are included. Finally, since the homogeneity of the oil shale is an important consideration in the selection of a site for these explosive fracture experiments, cores were taken and analyzed. The identification of the geological parameters and their extent and how they delineate the overall characterization of the experiment site, including the subsurface geology, is given. It is shown how the postshot core analysis will indicate how the blast affected the rock. M.D.K.

N82-25731# Geological Survey, Reston, Va.
A SUMMARY OF ENVIRONMENTAL GEOLOGIC STUDIES ON THE SOUTHEASTERN UNITED STATES ATLANTIC OUTER CONTINENTAL SHELF Final Open File Report, 1977 - 1978
P. POPENOE 1981 48 p refs
(PB82-109273; BLM/YL/SR-81/03) Avail: NTIS HC A03/MF A01 CSCL 08G

The outer continental shelf environment is investigated. The methods, techniques, instruments, and procedures utilized in acquiring sound management decisions regarding the development of mineral resources are summarized. GRA

N82-25780# California Univ., Irvine, Dayton, Ohio.
TOXIC HAZARDS RESEARCH UNIT Annual Technical Report, Jun. 1980 - May 1981
J. D. MACEWEN and E. H. VERNOT Wright-Patterson AFB, Ohio AMRL Dec. 1981 139 p refs
(Contract F33615-80-C-0512; AF PROJ. 6302; MF58524025)
(AD-A110587; AFAMRL-TR-81-126) Avail: NTIS HC A07/MF A01 CSCL 06T

Chronic toxicity or oncogenic studies were carried out with methylcyclohexane, purified 1,1-dimethylhydrazine, Otto Fuel II, JP-10, RJ-5, and JP-4. A subchronic inhalation study was conducted with shale derived JP-5 and Decalin fuels. Acute toxicity studies were conducted on a variety of chemical agents used by the Air Force and Navy. GRA

N82-25944# Los Alamos Scientific Lab., N. Mex.
SPACE NUCLEAR SAFETY AND FUELS PROGRAM Progress Report, May 1981
S. E. BRONISZ, comp. Oct. 1981 26 p refs
(Contract W-7405-ENG-36)
(DE82-004183; LA-9042-PR) Avail: NTIS HC A03/MF A01

The use of Plutonium 238 in radioisotopic power systems is discussed. A 250 W modular heat source fueled with Plutonium 238 was subjected to impact tests. All six fuel pellets cracked. The welding and weld inspection of the fuel pellet capsules is described. In preparation for overpressure tests of a lightweight radioisotope heater unit, attempts were made to experimentally reach launch pad pressures of 2000 psi. Eight helium release experiments using fragments of fuel pellets were completed. DOE

N82-25945# Los Alamos Scientific Lab., N. Mex.
SPACE NUCLEAR SAFETY AND FUELS PROGRAM Progress Report, Jun. 1981
S. E. BRONISZ, comp. Oct. 1981 16 p refs
(Contract W-7405-ENG-36)
(DE82-004188; LA-9076-PR) Avail: NTIS HC A02/MF A01

Studies related to the use of Plutonium 238 in radioisotope power systems are presented. Most of the studies discussed are ongoing. A lightweight radioisotope heater unit was tested. Nine calibration tests were completed to prepare for overpressure tests of the unit. A 250 W modular heat source fueled with Plutonium 238 was tested. Its iridium clads were subjected to impact tests. All four clads were cracked on impact. The microstructure of the welds were examined. DOE

N82-26053# Los Alamos Scientific Lab., N. Mex.
ANALYSIS OF ALTERNATE-FUELED PASSENGER VEHICLES: A SAMPLE TECHNOLOGY ASSESSMENT
A. T. PEASLEE, JR. and G. R. THAYER Oct. 1981 18 p refs
(Contract W-7405-ENG-36)
(DE82-004190; LA-9068-MS) Avail: NTIS HC A02/MF A01

Ten passenger vehicles powered by the following were characterized on a common engineering and economic basis: gasoline internal combustion, diesel internal combustion, liquid-hydrogen internal combustion, liquid-hydrogen fuel cell, hydrogen internal combustion, hydrogen fuel cell, methanol internal combustion, methanol fuel cell, Ni/Zn battery, and Pb/Acid battery. Levelized life cycle costs were computed for each vehicle. The market penetration of the nongasoline vehicles was studied over a 50 yr period using a generalized equilibrium energy economic model. Results indicate that only the methanol internal combustion vehicle using methanol produced from coal is a viable alternative to the gasoline internal combustion vehicle. The market penetration of alternate vehicles was enhanced more by reduction in acquisition costs than by comparable improvements in engineering parameters. DOE

N82-26303# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
COMBUSTION BEHAVIOR OF SOLID FUEL RAMJETS. VOLUME 2: EFFECTS OF FUEL PROPERTIES AND FUEL-AIR MIXING ON COMBUSTION EFFICIENCY Final Report
Aug. 1981 54 p refs
(AD-A110796; NPS67-81-011) Avail: NTIS HC A04/MF A01 CSCL 21E

Fundamental SFRJ fuel properties were determined using a DTA and a gas chromatograph for both high and low heating rates. The performance of these fuels was then measured under various operating conditions and test geometries. Fuel properties were found to have some effect on the obtainable combustion efficiency but much larger effects could be induced by the flow conditions (induced mixing near the fuel surface, bypass air, etc.). Author (GRA)

N82-26312# Monsanto Research Corp., Dayton, Ohio.
TURBINE ENGINE LUBRICANT RECLAMATION Interim Report, 1 Sep. 1979 - 1 Feb. 1981
G. L. BEEMSTERBOER and R. J. BRUNS Wright-Patterson AFB, Ohio AFWAL Dec. 1981 132 p refs HC A06/MF A01
(Contract F33615-79-C-2052; AF PROJ. 3048)
(AD-A112098; MRC-DA-1057; AFWAL-TR-81-2053) Avail: NTIS HC A06/MF A01 CSCL 11H

A distillation and adsorption treatment for reclaiming used MIL-L-7808 turbine oils was investigated. A viable additive package was tested on different MIL-L-7808 type virgin base stocks. Fifteen used oils were analyzed by acid number, high performance liquid chromatography, and gas chromatography. A distillation process utilizing caustic (sodium hydroxide) pretreatment was developed on 500-ml and 13-litre scales. Adsorption treatment of distilled oils with calcium hydroxide followed by attapulgus clay was examined. Preparations for large-scale (25 and 250 gal) reclamations are currently under way to elucidate the validity of caustic distillation and absorbent treatment parameters. Author (GRA)

N82-26422# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
CROSSED-REACTION NETWORKS IN THE CATALYTIC HYDRODENITROGENATION OF SYNTHETIC LIQUID FUELS Quarterly Report, 1 Aug. - 31 Oct. 1981
C. N. SCATTERFIELD and S. HSI 1981 8 p
(Contract DE-AC22-80PC-30075)
(DE82-003092; DOE/PC-30075/7) Avail: NTIS HC A02/MF A01

The effect of the ratio of hydrogen sulfide to quinoline on the HDN reaction was explored. Increasing the CS2/quinoline mole ratio to 2 caused a drop in total HDN activity from the maximum plateau level observed at a ratio of about 0.5. Throughout, an increase in this ratio causes a continuous enhancement of the hydrogenolysis reactions and inhibition of hydrogenation reactions in the reaction network. A large amount of kinetic data was taken using quinoline, BzTHQ (5,6,7,8-tetrahydroquinoline) and orthoprotpylaniline as a feed with various partial pressures of hydrogen sulfide present. The computer modelling of these kinetic data is still underway. The catalytic activity for HDN reaction increased with increased partial pressure of hydrogen sulfide during the initial sulfiding and resulfiding procedures. DOE

N82-26425# Gulf Research and Development Co., Pittsburgh, Pa.
FUNDAMENTALS OF COAL DEPOLYMERIZATION: KINETIC MODELING AND EXPERIMENTAL DETERMINATION OF FREE RADICAL CHEMISTRY AND MINERAL MATTER EFFECTS IN DIRECT COAL HYDROLIQUEFACTION Quarterly Report, 1 Jul. - 30 Sep. 1981
L. PETRAKIS, G. L. JONES, and D. W. GRANDY Sep. 1981 236 p refs
(Contract DE-AC01-79ET-14940)
(DE82-003689; DOE/ET-14940/6) Avail: NTIS HC A11/MF A01

Fundamental phenomena involved in coal depolymerization under hydroliquefaction conditions were investigated. The role of free radical formation and behavior on the degree of coal dissolution and the quality of the product are discussed. Electron spin resonance measurements of coal dissolution as it is affected by mineral matter were performed. Solids isolated from hydroliquefaction experiments were added to determine the effect of added mineral matter on free radical formation. The degree of liquefaction and the quality of product obtained were assessed. Standard separation techniques were used to obtain overall conversion fractions and solubility-defined fractions such as oils, preasphaltenes, and asphaltenes. The conversion data and the free radical formation are used to develop a kinetic/mechanistic model. DOE

N82-26426# Pittsburgh Univ., Dept. of Chemical and Petroleum Engineering.
SUPERCRITICAL FLUIDS FOR REACTION AND EXTRACTION OF COAL AND HEAVY OILS Quarterly Progress Report, 1 Sep. - 30 Nov. 1981
G. D. HOLDER, J. GOPAL, and G. V. DESHPANDE Dec. 1981 8 p
(Contract DE-FG22-81PC-40800)
(DE82-005496; DOE/PC-40800/1; QPR-1) Avail: NTIS HC A02/MF A01

A program for the study of supercritical extraction of coal and coal liquids is discussed. A fundamental understanding of supercritical extraction with emphasis on extraction of coal liquids with supercritical water and deashing of coal liquids, solvent refined coal - bottoms and possibly shale oils is sought. The use of supercritical extraction techniques for extraction and fractionation of heavy residues which are often mixed with mineral matter and other non-volatile matter is discussed. The supercritical extraction of model compounds and their mixtures is discussed. An experimental apparatus and procedure were designed and ordered. A schematic diagram of the experimental set-up is shown. A special custom-made autoclave reactor was designed. The reactor is a 1 liter Magnedrive 2 agitated autoclave rated at 500 psi and 450 C and provided with ports for inlet and outlet for the process components, temperature and pressure measurement and cooling water connections. The reactor will be provided with a multiple zone electric furnace for heating the reactor to operating conditions. The top of the reactor (flange), and sampling tubes will be provided with heating elements so as to maintain a constant temperature throughout the reactor and sampling line assembly. DOE

N82-26427# SRI International Corp., Menlo Park, Calif. Materials Research Lab.
MECHANISM OF CATALYTIC GASIFICATION OF COAL CHAR Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1981
B. J. WOOD, K. M. SANCIER, K. H. LAU, D. R. SHERIDAN, and H. WISE 15 Apr. 1981 56 p refs
(Contract DE-AC21-80MC-14593; SRI PROJ. 2202)
(DE82-004074; DOE/MC-14593/T1; QTPR-2) Avail: NTIS HC A04/MF A01

The mechanisms involved in the catalytic gasification reactions of coal char, from Illinois No. 6 coal, were studied and specific reaction steps and parameters that control the catalytic process were identified. To determine catalytic pathways and intermediate species, two experimental techniques were used. Temperature programmed reaction reveals the rate of formation of stable gaseous products and Knudsen cell mass spectrometry reveals the partial pressures of vapor species in equilibrium with the solid char. Physical measurements of the char including structural analysis (scanning electron microscopy), determination of internal surface area of char samples, (BET N2-isotherms) and evaluation of free-radical densities in char and carbons exposed to various pretreatments (electron spin resonance) were performed. Results suggest the operation of a redox couple (involving the catalyst cation) as a significant mechanistic step in the catalytic gasification of coal char. DOE

N82-26429# Battelle Columbus Labs., Ohio.
NOVEL APPROACH TO COAL GASIFICATION USING CHEMICALLY INCORPORATED CATALYSTS, PHASE 2 Final Report, May 1978 - Jun. 1981
H. F. FELDMANN, H. N. CONKLE, H. R. APPELBAUM, and S. P. CHAUHAN 1981 138 p refs
(Contract W-7405-ENG-92)
(DE82-003869; BMI-2088) Avail: NTIS HC A07/MF A01

A catalytic coal gasification system involving thorough incorporation of CaO catalyst into the coal is described. The catalytic treatment system can be used to improve both existing commercial gasification processes as well as advanced gasification systems. One gasification system that appears exceptionally attractive utilizing the treatment system is direct fluid bed hydrogasification or hydropyrolysis. A simple pressurized fluid bed steam/oxygen gasification system is also an attractive option which could be commercialized quickly. The technical and economic advantages of these approaches are demonstrated. DOE

N82-26430# Battelle Columbus Labs., Ohio.
NOVEL APPROACH TO COAL GASIFICATION USING CHEMICALLY INCORPORATED CATALYSTS, PHASE 2. APPENDIX A-F Final Report, May 1978 - Jun. 1981
H. F. FELDMANN, H. N. CONKLE, H. R. APPELBAUM, and S. P. CHAUHAN 1981 164 p refs
(Contract W-7405-ENG-92)
(DE82-003804; BMI-2088-APP-A-F) Avail: NTIS HC A08/MF A01

Data generated in investigations of a catalytic coal gasification system involving thorough incorporation of CaO catalyst into the coal are presented. Included are descriptions of the experimental apparatus, test conditions, and results of catalytic coal treatment; direct hydrogasification data; summaries of test runs for hydrogasification of BTC, hydrogasification of char, and steam/O2 gasification; and process analysis information. Forty tables and nine figures are also included. DOE

N82-26481*# National Aeronautics and Space Administration. Pasadena Office, Calif.
SUPERCRITICAL SOLVENT COAL EXTRACTION Patent Application
L. E. COMPTON, inventor (to NASA) (JPL, California Inst. of Tech., Pasadena) 17 Nov. 1981 18 p
(Contract NAS7-100)
(NASA-CASE-NPO-15210-1; US-PATENT-APPL-SN-322312)
Avail: NTIS HC A02/MF A01 CSCL 21D

Yields of soluble organic extract are increased up to about 50% by the supercritical extraction of particulate coal at a temperature below the polymerization temperature for coal extract fragments (450 C) and a pressure from 500 psig to 5,000 psig by the conjoint use of a solvent mixture containing a low volatility, high critical temperature coal dissolution catalyst such as phenanthrene and a high volatility, low critical temperature solvent such as toluene. NASA

N82-26484# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Fuels Branch.
JET FUEL FROM SHALE OIL: THE 1981 TECHNOLOGY REVIEW
H. R. LANDER, JR. Dec. 1981 257 p refs Proceedings of Symp., Miamisburg, Ohio, 17-18 Nov. 1981
(Contract AF PROJ. 3048)
(AD-A111217; AFWAL-TR-81-2135) Avail: NTIS HC A12/MF A01 CSCL 21D

The 'Jet Fuel From Shale Oil - 1981 Technology Review' culminated three years of Air Force Shale Oil related programs. Final economic optimized results of three processing studies evaluating the yield, cost and quality of JP-4 and JP-8 jet fuel produced from whole crude shale oil are discussed. Reported also are technologies associated with a newly developed nitrogen tolerant catalyst and conclusions of combustion studies performed on shale derived JP-4 jet fuel samples and Nuclear Magnetic Resonance (NMR) analyses of the composition of shale derived jet fuel samples. Author (GRA)

N82-26485# Center for Naval Analyses, Alexandria, Va. Naval Studies Group.
MOBILITY FUELS FOR THE NAVY
T. ONEILL Jan. 1982 21 p refs
(Contract N00014-76-C-0001)
(AD-A112511; CNA-PP-336) Avail: NTIS HC A02/MF A01 CSCL 21D

As fuel declines, both specifications and engine designs will have to be modified to accommodate this change. In addition, specifications have to reflect the fact that fuel chemistry itself is undergoing change, so that new problems have begun to arise. Recently, batches of DFM and JP-5 that passed inspection have been associated with fuel filter clogging and excessive smoking. The mechanisms of these effects are not clearly understood. As synfuels are introduced, the variety of chemicals in fuels will be greatly expanded, and this will cause a new range of problems. Besides modifying the specifications of current fuels to address the issues of price and availability, other ways might come from changing the types of fuel burned. The Navy could attempt to switch to fuels in civilian use. Number 2 diesel oil is similar to the ship fuel DFM, while Jet A-1 is not unlike the aircraft fuel JP-5. Another approach could involve the use of just one type of fuel for both ships and airplanes. This would reduce storage and handling costs, perhaps enough to offset the modest differential of 5 cents per gallon between JP-5 and DFM that existed in October 1981. GRA

N82-26486# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
IMPACT OF GASOHOL ON THE L-141 AND LDT-465-1C ENGINES Interim Report, Oct. 1980 - Sep. 1981
W. E. LIKOS and D. M. YOST Dec. 1981 110 p refs
(Contract DAAK70-80-C-0001; DAAK70-82-C-0001; DA PROJ. 1L2-63104-D-150)
(AD-A112010; AFLRL-148) Avail: NTIS HC A06/MF A01 CSCL 21D

Gasohol was analyzed in the L-141 and LDT-465-1C engines in order to determine its impact upon engine operability. During various steady-state operating conditions, with the L-141 engine, gasohol was found to improve economy under heavily loaded conditions, while a deterioration will occur during light and intermediate loading. An evaluation of emission and nonemission-regulated carburetors shows the nonemissions carburetor better suited for gasohol use. No effects on maximum power produced were noted with gasohol. Simulated driveability tests with the L-141 engine on a dynamometer showed differences in engine response between the different fuels, but actual vehicle tests proved that driveability was not altered. A relatively short endurance test with the L-141 engine on gasohol fuel indicates, based on engine oil analysis, no significant change in engine wear rates. The endurance test did indicate, however, that more frequent oil drain intervals may be required due to TBN depletion of the engine oil. Cold start testing of the LDT-465-1C engine indicates that gasohol is of inadequate cetane number to sustain normal engine operation. Thus, it is recommended that gasohol not be used in the LDT-465 family of engines. Author (GRA)

N82-26487# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
DEVELOPMENT OF ARMY HIGH-ENERGY FUEL DIESEL/TURBINE-POWERED SURFACE EQUIPMENT, PHASE 2 Interim Report, Oct. 1979 - Sep. 1981
W. W. WIMER and D. M. YOST Dec. 1981 134 p refs
(Contract DAAK70-80-C-0001; DAAK70-82-C-0001; DA PROJ. 1L7-62733-AH-20)
(AD-A111942; AFLRL-147) Avail: NTIS HC A07/MF A01 CSCL 21D

The Army is interested in those fuels that have a high-energy content per unit volume and therefore result in increased payload capabilities and/or extended operational range of the vehicle. A series of screening processes are being used to identify those fuels and/or fuel components that could result in an increase of 10 percent in the range of the vehicle without an increase in the fuel tank size, i.e., fuels with a high-energy content percent volume. The chemical and physical properties of various candidate fuels and fuel components are described. The fuel components included both liquids and solids (at room temperature). The blending of the various components and the characterization of the resulting fuels are outlined. Solubility studies were done on some of the solid components to assist in obtaining the resulting fuel in the more desirable liquid state. Those solid components, such as anthracene, that were insoluble in the tests conducted but judged to have good high-energy potential, were studied as slurries. Catalyzed 'carbon black' was investigated. Settling studies with carbonaceous fuels included the effect of temperature upon the stability, the stability of FRF-carbon slurries, and the refinement of the previously reported 'Freezing Tube Technique' for measuring stability. Impact dispersion tests were conducted to study the fire-safety characteristics of energy-augmented fuels. The screening of candidate fuels with the Petter engine is described in detail. Other engine studies with the CLR engine are also included.
Author (GRA)

N82-26488# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
REVIEW OF PHYSICAL AND CHEMICAL METHODS FOR CHARACTERIZATION OF FUELS Interim Report, Mar. 1980 - Dec. 1981
R. G. ZOSCHAK and L. L. STAVINOHA Dec. 1981 246 p refs
(Contract DAAK70-80-C-0001; DAAK70-82-C-0001; DA PROJ. 1L7-62733-AH-20)
(AD-A111943; AFLRL-151) Avail: NTIS HC A11/MF A01 CSCL 21D

This report provides a tabulation of chemical compounds and physical/chemical properties with methods for their determination based on a review of physical and chemical methods for characterizing liquid mobility fuels. This tabulation is cross-referenced to a list of references organized by preselected categories. A complete bibliography is provided alphabetically by author's last name, both with and without annotations. For ease in utilization and updating, a system was developed to facilitate tabulation and recall of references from a word processor in which they are stored. While this tabulation serves as reference material to a program to develop improved analytical and correlative methodology for characterizing fuels, it may be of great utility to personnel developing and analyzing fuels. This tabulation will continue to be expanded and updated periodically.
Author (GRA)

N82-26492# Texas Univ., Austin. Center for Energy Studies.
SYNTHETIC-FUEL PRODUCTION USING TEXAS LIGNITE AND A VERY HIGH TEMPERATURE GAS COOLED REACTOR FOR PROCESS HEAT AND ELECTRICAL POWER GENERATION
M. A. ROSS and D. E. KLEIN May 1981 90 p refs
(DE82-900466; UT/CES-RR-13) Avail: NTIS HC A05/MF A01

Two alternatives to increased reliance on foreign energy sources are presented which utilize the abundant domestic resources of coal, uranium, and thorium. The gasification and liquefaction of coal are accomplished with Lurgi gasifiers and Fischer-Tropsch synthesis. A 50,000 barrel per day facility, consuming 15 million tons of lignite coal per year, is used. A nuclear assisted coal conversion approach using a very high temperature gas cooled reactor with a modified Lurgi gasifier and Fischer-Tropsch synthesis is also described. DOE

N82-26493# California Univ., Livermore. Lawrence Livermore Lab.
LLNL UNDERGROUND COAL-GASIFICATION PROJECT Quarterly Progress Report, Apr. - Jun. 1981
D. U. OLNESS, ed. and W. CLEMENTS, ed. 27 Jul. 1981 41 p refs
(Contract W-7405-ENG-48)
(DE82-002074; UCRL-50026-81-2) Avail: NTIS HC A03/MF A01

Laboratory studies of forward gasification in small blocks of coal, approximately 12 inches on a side are discussed. The coal is ignited near the inlet to a small hole drill through the center of the block, and a steam/oxygen mixture is fed through the hole to support the combustion. The ability to visually inspect the gasification cavities formed in these laboratory-scale experiments enhances understanding of the in situ gasification process. At the end of each experiment the coal block is split open and the cavity is examined. It was found that for the three coals studied for far (two from Wyoming and one from Washington) the cavities appear quite different, yet the product-gas heating values are very similar. A mathematical model for the small coal block experiments is under development in order to improve understanding of the physical and chemical processes governing the burning of the coal and the growth of the cavity within the block. Combined chemical kinetic and mass transfer rates were developed for the model. Results with the model were compared against experimentally observed cavity shapes burned in coal. DOE

N82-26495# Illinois Univ., Urbana. Dept. of Agricultural Engineering.
ALCOHOL DISTILLATION BY INTERNAL-COMBUSTION ENGINES Final Report
D. HUNT 20 Nov. 1981 6 p
(Contract DE-AC02-81AF-92002)
(DE82-005294; DOE/AF-92002/1) Avail: NTIS HC A02/MF A01

An internal combustion engine was fitted with an apparatus to enable waste heat capture for the distillation of fermented corn beer into 180-proof ethanol engine fuel. A performance test was conducted in the continuous mode of operation. DOE

N82-26496# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.
CONVERSION OF CELLULOSIC WASTES TO LIQUID FUELS Interim Report
J. L. KUESTER Sep. 1981 77 p refs
(Contract DE-AS02-76CS-40202)
(DE82-001173; DOE/CS-40202/T5; COO-2982-74) Avail: NTIS HC A05/MF A01

The history, current status, and future plans for a project to convert waste cellulosic (biomass) materials to liquid hydrocarbon fuels are described. The process utilizes an indirect liquefaction approach (gasification followed by liquefaction) to produce a quality liquid hydrocarbon product similar to diesel fuel. A variety of feedstocks can be processed with product quality essentially independent of feedstock type. Operation of the system in an integrated, continuous mode and direct measurement and assessment of product yields are described. Additional factor studies (gasification, fluidizing gas type, solid type, and operating conditions) were also performed. DOE

N82-26497# Energy and Minerals Research Co., Exton, Pa.
APPLICATION OF ULTRASONIC TECHNIQUES TO CHEMICAL COAL CLEANING PROCESSES Final Report, 15 Apr. 1980 - 15 Aug. 1981
W. B. TARPLEY, JR., E. N. TWESME, P. L. HOWARD, and G. R. MOULDER Aug. 1981 52 p refs
(Contract DE-AC22-80PC-30143)
(DE82-003093; DOE/PC-30143/T4) Avail: NTIS HC A04/MF A01

Ultrasonic activation was applied to several coal cleaning processes, including chlorinolysis, oxygesulfurization, and sodium hypochlorite leaching, in small-scale batch treatment processing of Illinois No. 6, Lower Kittanning, and Western Kentucky No. 11 coals. In all cases, ultrasonic energy application demonstrated effects that would translate in production to processing efficiencies and/or capital equipment savings. Specifically, in the chlorinolysis reaction, pyritic sulfur was removed 23 times faster with ultrasonics than without it. (Organic sulfur could not be removed from the coal examined with or without ultrasonics in the chlorinolysis process). In sodium hypochlorite leaching, the total sulfur extraction rate was 3 times faster with ultrasonics. Two separate benefits were seen with oxydesulfurization: ultrasonics doubled the reaction rate and at slightly accelerated rates allowed a pressure reduction from 960 to 500 psi, which would be a significant cost efficiency in production. DOE

N82-26498# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.
MOLTEN SALT COAL GASIFICATION PROCESS DEVELOPMENT UNIT, PHASE 2 Quarterly Progress Report, Apr. - Jun. 1981
M. H. SLATER 21 Jul. 1981 57 p
(Contract DE-AC21-77ET-10296)
(DE82-004717; DOE/ET-10296/194; QTPR-4) Avail: NTIS HC A04/MF A01

A molten salt coal gasification process development unit (PDU) program is discussed. A one-year operations program utilizing the existing PDU was planned to include a series of runs, each additional run progressively utilizing more plant hardware and subsystems and operating under increasingly severe conditions.

Run 7 data were evaluated and reported continuously on schedule for a full 7 days; the melt overflow system operated smoothly throughout the entire gasification program; a coal throughput of approximately 1 TPH, the rated design capacity of system, was achieved; the gasifier/quench system operated satisfactorily at a planned 15% ash in the melt; and the gasification system operated as predicted at 10-atm pressure over extended periods and satisfactorily at pressures up to 18 atm. The ash removal, sulfur removal, and sodium carbonate regeneration systems were all placed on line during the run. During Run 9 Illinois No. 6 coal was gasified at 20 atm pressure and at coal throughput of nominal 1 TPH and the gasifier was operated with the ash content in the melt at the design 20% concentration. The post-test inspection after PDU Run 9 is continued. Data reduction, data evaluation, and performance analysis of the various components and subsystems in the balance of plant are in progress. DOE

N82-26499# Westinghouse Electric Corp., Madison, Pa. Synthetic Fuels Div.

ADVANCED COAL GASIFICATION SYSTEM FOR ELECTRIC POWER GENERATION Quarterly Progress Report, 1 Jan. - 31 Mar. 1981

22 Apr. 1981 53 p

(Contract DE-AC21-80ET-14752)

(DE82-004539; DOE/ET-14752/16; QPR-2) Avail: NTIS HC A04/MF A01

Major activity was directed toward maintenance and modification of the process development of a pressurized fluidized bed gasification system. Currently, final assembly and preparation are in progress for tests to be conducted. The last part of commissioning test TP-M001-4, which is a functional checkout of the model structure and associated subsystems, was completed. From the experiments performed in a bed of wide size particle distribution, the two dimensional, wedge-shaped pitot tube with continuous gas purge successfully prevented the plugging of the tube holes over a long period of operation and simultaneously provided the required sensitivity of measurement. The pitot tube was calibrated in the wind tunnel at 0, 250, 310, and 390 cm(3)/m purge flow. These results will provide guidance for the operation of the purged pitot tube in the cold flow scaled-up facility. A simple mathematical model was proposed to estimate the solids circulation rate induced by a bubbling jet. Certain parameters in the model will require verificaton from cold flow experiments designed for this purpose. Two series of experiments were completed to investigate the motion of solid particles in the gasifier. The rate of particle mixing was studied as a function of the jet injection velocity. DOE

N82-26501# Utah Univ., Salt Lake City. Dept. of Mining and Fuels Engineering.

CONCEPTS OF FUNDAMENTAL PROCESSES RELATED TO GASIFICATION OF COAL Quarterly Progress Report, Oct. - Dec. 1980

W. H. WISER May 1981 6 p

(Contract DE-AM03-77SF-01484)

(DE81-023067; DOE/SF-01484/T1; FE-1484-5) Avail: NTIS HC A02/MF A01

Single stage catalytic coal gasification, single stage coal gasification to high Btu gas, and reactions of aromatic compounds with steam are discussed. The objective of the first project is to optimize the process variables and catalyst systems to maximize methane yields. The objective of the second investigation is to investigate the potential for obtaining high methane yields by direct catalytic hydrogenation of coal in a single stage with a maximum temperature of 550 C. The objectives for project three are: to develop a catalyst of suitable activity and sufficient life; to determine the conversion and approach to equilibrium as a function of the main variables of the reaction (temperature, pressure, contact time and steam/carbon ratio); and to determine reaction mechanisms and kinetics of the reforming reactions. Various construction activities are reported. DOE

N82-26502# Utah Univ., Salt Lake City. Dept. of Mining and Fuels Engineering.

CONCEPTS OF FUNDAMENTAL PROCESSES RELATED TO GASIFICATION OF COAL Quarterly Progress Report, Apr. - Jun. 1981

W. H. WISER Sep. 1981 8 p

(Contract DE-AM03-77SP-01484)

(DE82-000764; DOE/SF-01484/T3; FE-1484-7) Avail: NTIS HC A02/MF A01

Single stage catalytic coal gasification and the reaction of aromatic compounds with steam are discussed. The primary objective of the coal gasification is to optimize the process variables and catalyst systems to maximize methane yields. During this quarter, the gasification system was set up and pressure tested. The electrical system was also completed and is functional. The thermocouples and slurry feed system are being installed. The purpose of the steam process study is to assess the feasibility of coal liquefaction-steam reforming of coal-derived liquids for the production of synthesis gas and hydrogen. To date, a reactor has been built which is composed of two zones: the preheat and reaction zone and the control and product analysis zone. The Packard 7400 series gas chromatography system was redesigned. A thermal conductivity detector for H2, CO and CO2 analysis and flame ionization detector for hydrocarbon analysis can be used at the same time. The flow rates (water and benzene) and percent stroke (controlled volume pump) were established. Preliminary experiments were attempted with steam benzene mixtures at atmospheric pressure to establish the operating and analytical procedure. DOE

N82-26692# General Electric Co., Schenectady, N. Y. Gas Turbine Div.

HIGH-TEMPERATURE TURBINE TECHNOLOGY PROGRAM ROTOR WATER DELIVERY AND DISTRIBUTION TESTS

M. W. HORNER Sep. 1981 107 p refs

(Contract DE-AC01-76ET-10340; EX-76-C-01-1806)

(DE82-000400; DOE/ET-10340/120) Avail: NTIS HC A06/MF A01

The design, fabrication, and test of a rotor water delivery and distribution system for an integrated gasification combined cycle power plant typical of the technology readiness vehicle (TRV) high temperature turbine (HTT) design conditions are described. The delivery and distribution of bucket cooling water were evaluated. This included water transfer onto the rotor, water metering to individual buckets, and water distribution among the cooling passages within each bucket. This task was accomplished by conducting rotating tests at the TRV gravitational force level and a wide range of water flow rates to demonstrate the following technology: transfer of water from a stationary supply onto the turbine rotor using a water commutator; delivery of water through the rotor to a circumferential manifold and its uniform metering to the individual buckets via individual orifices (one orifice to feed one bucket); uniform distribution of water to the cooling passages of each bucket via a resistance flow divider (RFD) at the bucket dovetail; and verification of turbine rotor dynamic stability with varying water flows and rotor speeds. Critical components of a water delivery and distribution system for an HTT water cooled gas turbine rotor were evaluated at typical TRV design conditions of water flow and gravitational force level and the concept and the system validated. Rotor dynamics behavior was not adversely affected by the presence of water in the rotor distribution components. DOE

N82-26695# Westinghouse Research and Development Center, Pittsburgh, Pa. Nuclear Components Div.
DEVELOPMENT OF AUTOMATED WELDING PROCESS FOR FIELD FABRICATION OF THICK WALLED PRESSURE VESSELS Final Report
I. STOL 4 Nov. 1981 190 p
(Contract DE-AC05-78ET-13511)
(DE82-004421; DOE/ET-13511/T11) Avail: NTIS HC A09/MF A01

Procedure development and qualification for narrow groove gas tungsten arc welding of SA 387 Grade 22 Class 2 steel (2 1/4% Cr-1% Mo) to 4 inch thickness is reviewed. Welding was conducted in the horizontal and vertical position. DOE

N82-26771# Midwest Research Inst., Golden, Colo.
ASSESSMENT OF SECONDARY RESIDUES. ENGINEERING AND ECONOMIC ANALYSIS Final Report
A. P. LEUSCHNER, C. E. WEST, and E. ASHARE Aug. 1981 279 p refs
(Contract DE-AC02-77CH-00178)
(DE82-000925; SERI/TR-98175-3) Avail: NTIS HC A13/MF A01

Case studies investigating the costs of converting liquid and/or solid secondary agricultural residuel streams to methane and/or ethanol. Several economically feasible examples were found: methane production from potato processing liquid residues, ethanol from potato processing solid residues, methane from cheese processing wastes, and methane from poultry processing liquid wastes. In facilities which operate year round, energy recovery is often feasible, whereas in seasonal operations, economic feasibility is not possible. Economic feasibility of energy production from secondary residues is strongly dependent on the current use of the solid and liquid residue. If the solid residue is sold as an animal feed, energy production is usually not economical. High solid and liquid residue disposal costs often make energy conversion economically feasible. DOE

N82-26911# California Univ., Livermore. Lawrence Livermore Lab.
MECHANICAL BEHAVIOR OF MESAVERDE SHALE AND SANDSTONE AT HIGH PRESSURE
W. LIN Apr. 1981 13 p refs Presented at SPE/DOE Low Permeability Symp., Denver, 27-29 May 1981 Submitted for publication
(Contract W-7405-ENG-48)
(DE82-001665; UCRL-85808) Avail: NTIS HC A02/MF A01

Rock mechanics measurements taken on Mesaverde shale (source rock) and sandstone (reservoir rock) from about 350 m depth (Colorado) and 1600 m depth (Wyoming) are reported. For each sandstone and shale, the following properties were determined: (1) tensile strength parallel and perpendicular to bedding, 0.1 MPa pressure; (2) triaxial stress failure envelope in compression to 300 MPa confining pressure, parallel and perpendicular to bedding; (3) pressure volume behavior to 1.2 GPa. The results for (1) indicate that, in general, the tensile strength of Wyoming sandstone is about three times that of Colorado sandstone. For both sandstones, the tensile strength is isotropic with respect to bedding. The tensile strength of both shales parallel to bedding is about 30 to 50% greater than that measured normal to bedding. The shale from Wyoming has a tensile strength about 25 to 50% greater than that from Colorado. Strengths and failure modes in compression (2) show that the transition between brittle failure and ductile deformation occurs at a confining pressure of about 0.1 GPa for the Colorado sandstone and 0.25 GPa for all other rocks tested. DOE

N82-26915# California Univ., Livermore. Lawrence Livermore Lab.
SEISMIC AND GEODETIC STUDIES OF THE IMPERIAL VALLEY, CALIFORNIA Final Technical Report
D. D. JACKSON (UCLA) 1 May 1981 50 p refs
(Contract W-7405-ENG-48)
(DE82-001686; UCRL-15382) Avail: NTIS HC A03/MF A01

Patterns of gravitational and thermal anomalies, strike slip faulting, volcanism in the Imperial Valley were investigated. These patterns suggest that the continental crust may still be spreading. In recent years, the United States Geological Survey and Caltech have added new seismic stations into a dense network in the Imperial Valley to study in detail the relationship between geothermal areas and earthquakes, and to understand the tectonic processes taking place there. The following areas were examined: (1) crustal structure data on P wave arrival times of local earthquakes; (2) leveling data for evidence of tectonic subsidence or uplift; and (3) correlations between seismicity, seismic velocity, geodetic motion, geothermal activity, and local geology. DOE

N82-27317# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
DEVELOPMENT OF ACCELERATED FUEL-ENGINES QUALIFICATION PROCEDURES METHODOLOGY, VOLUME 1 Interim Report, Oct. 1980 - Sep. 1981
J. A. RUSSELL, J. P. CUELLAR, JR., J. C. TYLER, J. ERWIN, W. K. KNUTSON, R. A. ALVAREZ, R. L. STENBERG (Army Aviation Research and Development Command), F. O. ZIMMER (Army Aviation Research and Development Command), R. L. RENTA (Mueller Associates, Inc.), and T. J. TIMBARIO (Mueller Associates, Inc.) Dec. 1981 216 p refs 2 Vol.
(Contract DAAK70-81-C-0209; DAAK70-80-C-0001; DAAK70-82-C-0001; DA PROJ. 1L2-63104-D-150)
(AD-A113461; AFLRL-144-VOL-1) Avail: NTIS HC A10/MF A01 CSCL 15E

Activities and findings are reported for a 12-month program aimed at the development of procedures for accelerating the qualification of new fuels on Army equipment, emphasizing those derived from oil shale and coal. Prinicpal activities were identification of key tactical and combat surface and air vehicles, powerplants, and fuels systems components; identification of critical properties peculiar to new fuels anticipated to have significant impact upon Army materiel; laboratory evaluations of materials compatibility and fuels characteristics (including lubricity, elastomer compatibility, thermal stability, and corrosion); full-scale fuel systems component testing, and an overall review and evaluation of existing engine/fuel system qualification procedures. Conclusions and recommendations are presented in terms of methodology and criteria which will realistically address key peculiarities of altnerative fuels and thus serve to accelerate their qualification for field Army use. Author (GRA)

N82-27318# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
DEVELOPMENT OF ACCELERATED FUEL-ENGINES QUALIFICATION PROCEDURES METHODOLOGY. VOLUME 1: APPENDICES Interim Report, Oct. 1980 - Sep. 1981
J. A. RUSSELL, J. P. CUELLAR, JR., J. C. TYLER, J. ERWIN, R. A. ALVAREZ, W. K. KNUTSON, R. L. STENBERG (Army Aviation Research and Development Command), F. O. ZIMMER (Army Aviation Research and Development Command), R. L. RENTZ (Mueller Associates, Inc.), T. J. TIMBARIO (Mueller Associates, Inc.)et al. Dec. 1981 438 p 2 Vol.
(Contract DAAK70-81-C-0209; DAAK70-82-C-0001; DAAK70-80-C-0001)
(AD-A113532; AFLRL-144-VOL-2) Avail: NTIS HC A19/MF A01 CSCL 15E

Aircraft engine component listings are included, along with elastomer swell and hardness data and retention properties. Several shale oil fuel test plans are presented. Pre and post test definition data, spot calibration, flow test, fuel characteristics, lubricity and interfacial tension data are also given. Component test results, disassembly and inspection, identification of critical

fuel system components, and existing engine qualification procedures are also included. S.L.

N82-27451# Gulf Research and Development Co., Pittsburgh, Pa.
INVESTIGATION OF MECHANISMS OF HYDROGEN TRANSFER IN COAL HYDROGENATION Quarterly Progress Report, Mar. - Jun. 1981
D. C. CRONAUER Sep. 1981 52 p refs
(Contract DE-AC22-80PC-30080)
(DE82-004407; DOE/PC-30080/5) Avail: NTIS HC A04/MF A01

Model compound and coal liquefaction experiments were carried out in a stainless steel tubular reactor at 4500 C to observe the effects of hydrogen transfer on solvent isomerization. Significant observations are that: (1) methylindan production from tetrain in the presence of dibenzyl took place by at least two different mechanisms, only one of which involved the normal cracking dibenzyl; (2) deuterium hydrogen isotope studies with model compounds and coal liquefaction indicated that kinetic data from the model compound experiments should be applied to coal liquefaction only with caution; and (3) solvent isomerization by ring contraction is a problem in recycle operation due to the low hydrogen donor capability and exceptional stability of the rearranged product. DOE

N82-27453# Colorado School of Mines, Golden. Dept. of Chemical and Petroleum Refining Engineering.
MECHANISMS AND KINETICS OF COAL HYDROGENATION Quarterly Progress Report, Jul. - Sep. 1981
R. M. BALDWIN Oct. 1981 52 p
(Contract DE-AC22-79ET-14881)
(DE82-004867; DOE/ET-14881/7) Avail: NTIS HC A04/MF A01

A coal hydrogenation research project is described. The rates of coal hydrogenation in continuous flow stirred tank and tube flow reactors using pure hydrogen, catalyzed CO-STEAM, and syngas processing conditions are compared. The influence of coal properties on the rate of hydrogenation of coal to preasphaltenes, asphaltenes, and oil in batch reactors is studied. The effect of operating conditions (temperature, added catalysts, and pressure) on the rate of hydrogenation of coal derived preasphaltenes and asphaltenes is studied. The effect of selected disposable catalysts on the rate of batch hydrogenation of selected bituminous coals is studied. Promising catalyst systems in the continuous processing units are tested. A unified kinetic/mechanistic model was formulated for coal liquefaction taking into account petrography of the feed coal and hydrocarbon lumps in the product oil. DOE

N82-27454# Pittsburgh and Midway Coal Mining Co., Shawnee Mission, Kans.
RESEARCH ON SOLVENT REFINED COAL Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1981
Nov. 1981 67 p
(Contract DE-AC22-81PC-40005)
(DE82-004535; DOE/PC-40005/1) Avail: NTIS HC A04/MF A01

Pittsburgh seam coals from the Powhatan No. 3, Powhatan No. 6, McElroy, Robinson Run and a blend of coals from the Powhatan No. 6 and Ireland Mines were evaluated as feedstocks for major liquefaction facilities. Yields and operability with all of these coals were found to be generally satisfactory at normal SRC II operating conditions. In addition, a series of runs was conducted in the SRC II mode with Pittsburgh seam coal from the Powhatan No. 5 Mine at conditions expected to produce high oil yields. Oil yield was increased and SRC yield decreased significantly by increases in pressure, residence time and recycle solids levels over those normally used. T.M.

N82-27456# Physical Sciences, Inc., Woburn, Mass.
PULVERIZED-FUEL COMBUSTION: MODELING AND SCALEUP METHODOLOGIES Quarterly Report, 1 Jul. - 30 Sep. 1981
P. F. LEWIS and N. H. KEMP Dec. 1981 18 p refs
(Contract DE-AC22-80PC-30294)
(DE82-004790; DOE/PC-30294/4; QR-4) Avail: NTIS HC A02/MF A01

Models of small to medium scale pulverized fuel combustors were developed. Scaling laws for flame stability and carbon carry over were developed also. Work was confined to the data analysis task. A sample computation and the influence of various phenomena on the results are discussed. T.M.

N82-27459# National Bureau of Standards, Washington, D.C.
MODELLING OF OIL SHALE RETORTS FOR ELECTROMAGNETIC SENSING TECHNIQUES Final Report
H. CHEW Nov. 1981 48 p refs Sponsored in part by DOE Clarkson College, Potsdam, N.Y.)
(PB82-153321; NBSIR-81-1653) Avail: NTIS HC A03/MF A01 CSCL 07A

The feasibility of determining the void ratio of oil shale retorts by remote electromagnetic measurement is evaluated. The retort is modelled by a spheroid with an average dielectric constant which depends on the void ratio. The near field due to a radiating dipole source in the vicinity of a spheroidal retort is computed using the extended boundary condition method of Waterman, Barber, and Yeh. Numerical results are given at 4 MHz for a retort with major axis 45.7 (150 ft), minor axis 25.1 m (82.5 ft), bulk dielectric constant 8.8 + 3.7, and various void ratios. GRA

N82-27516# Bayerisches Geologisches Landesamt, Munich (West Germany).
THE BOREHOLES ORTENBURG 1 AND 2 (1980/81) Final Report
H. GUDDEN and H. SCHMID Bonn Bundesministerium fuer Forschung und Technologie Feb. 1982 35 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-004; ISSN-0340-7608; REPT-203.1.8-IV/2C)
Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 7,40

Prospecting on the Ortenburg plateau is described. Permian and mesozoic sedimentary rocks of the variscan orogene area are often U, Cu, Pb and Cu bearing, especially layers of reduced thickness and reducing environment as well as the border between crystalline basement and overlying rocks. The outcrops of these rocks are well investigated except where the prospected series are covered by younger formations. The few borings in this region corroborate their interest. Therefore, the boreholds Ortenburg 1 and 2 were sunk, reaching the crystalline basement by a 1 m clastic layer, under tertiary, cretaceous and mesozoic rocks. Chemical analyses show amounts up to 0.15% Pb and 0.1% Cu in the weathered basement and the clastic layer. At the basement top there are peaks in the Gamma Log with intensities of 2x to 3x crystalline background. Author (ESA)

N82-27520# Georgetown Univ., Washington, D.C. Dept. of Chemistry.
FRACTIONATION OF DIESEL FUEL FROM PETROLEUM AND PARAHO SHALE OILS Final Report
C. F. HAMMER Oct. 1981 22 p refs
(Contract N00167-76-M-8549; ZF45451001)
(AD-A107042; DTNSRDC/SME-80/212) Avail: NTIS HC A02/MF A01 CSCL 21D

A fractionation scheme has been developed to separate diesel fuels into neutral water solubles, acidic components, basic components, saturated hydrocarbons, substituted benzenes, polycyclic aromatic hydrocarbons, and polar neutrals. A sample of conventional petroleum diesel fuel and a sample of diesel fuel derived from Paraho crude shale oil by the Gary-Western process were fractionated by this procedure. Each fraction was further analyzed by gas chromatography and proton magnetic resonance spectroscopy. The petroleum sample was found to contain 17.5%

total aromatics of which 9.5% were polycyclic aromatic hydrocarbons compounds. However, the Paraho-Gray Western shale oil fuel contained about twice as much total aromatics (38.2%) and polycyclic aromatic hydrocarbons compounds (19.3%). The total acyclic hydrocarbon straight chain compounds content was 66.7% for the petroleum sample and 59.3% for the Paraho-Gary Western shale sample. Suggestions for further work are also made. Author (GRA)

N82-27522# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.

SUITABILITY OF SHALE FUELS FOR ARMY GENERATOR SETS Interim Report, May 1980 - Sep. 1981

A. F. MONTEMAYOR Dec. 1981 69 p refs

(Contract DAAK70-80-C-0001; DAAK70-82-C-0001; DA PROJ. 1L7-62733-AH-20)

(AD-A112609; AFLRL-142) Avail: NTIS HC A04/MF A01 CSCL 21D

Gasoline, diesel, and gas turbine generator sets were examined to determine which shale fuel properties might adversely affect their performance, Information from engine manufacturers, fuel system manufacturers, U.S. Army Troop Support and Aviation Readiness Command (USATSARCOM) personnel and existing literature was consulted to identify existing/potential problems. Known shale fuel properties were presented and compared to military specifications. Generator sets were separated into major grouping by the fuel systems they employ. A listing of generator sets was included in order to facilitate generator set selection for testing. In general, the performance of shale fuels seemed to be comparable to that of petroleum fuels. Long-term problems such as elastomer degradation, poor life, and difficult cold weather starting may manifest themselves if refiners are unable to meet military specifications. Based on the fuels produced to date, refiners should be able to meet specifications and provide shale fuels suitable for generator set operation. Several fuel properties not covered in military specifications (such as lubricity and hydrocarbon composition) were seen as potential problem areas. A recommended test procedure has been provided to test the areas of concern presented in this report. Author (GRA)

N82-27523# Amoco Oil Co., Naperville, Ill. Research and Development Dept.

EVALUATION OF HYDROCRACKING CATALYSTS FOR CONVERSION OF WHOLE SHALE OIL INTO HIGH YIELDS OF JET FUELS Final Report, Dec. 1979 - Oct. 1981

A. M. TAIT and A. L. HENSLEY Wright-Patterson AFB, Ohio AFWAL Oct. 1981 196 p refs

(Contract F33615-79-C-2095; AF PROJ. 3048)

(AD-A112820; M81-65; AFWAL-TR-81-2098) Avail: NTIS HC A09/MF A01 CSCL 21D

A catalyst development and screening program has led to a formulation capable of upgrading whole shale oil into high yields of military jet fuel in a single operation. The catalyst is multifaceted in its functionality in that it sequentially saturates, denitrogenates, and hydrocracks the feedstock in the presence of high levels of contaminants, such as organic nitrogen compounds and ammonia, while maintaining a high selectivity towards jet-fuel, boiling range material. The catalyst, developed by optimization of both chemical and physical properties, consists of 1.5% cobalt oxide, 10% chromium oxide, and 15% molybdenum oxide on a support of 50% ultrastable molecular sieve in alumina. The effectiveness of the catalyst for the direct upgrading of an Occidental whole shale oil was demonstrated in a 100-day test. The feed, containing approximately 15 weight percent material boiling within the range for JP-4 and containing 13,000 ppm nitrogen, was upgraded to a water-white product containing 1 to 3 ppm nitrogen and approximately 75% JP-4 material. The hydrogen consumption required for this level of upgrading and conversion was approximately 1800 SCFB. The catalyst developed represents an advance in shale oil upgrading technology over more conventional petroleum-based technology. Author (GRA)

N82-27524# Simmonds Precision Products, Inc., Vergennes, Vermont.

COMMERCIAL AIRCRAFT AIRFRAME FUEL SYSTEMS SURVEYS Interim Report, Oct. 1980 - Oct. 1981

P. G. WEITZ Atlantic City FAA Feb. 1982 55 p refs

(Contract DTFA03-80-C-0080)

(AD-A112241; E-2304; FAA-CT-82-12) Avail: NTIS HC A04/MF A01 CSCL 20D

A selection of commercial aircraft airframe fuel systems has been studied to determine areas where incompatibility with antimisting kerosene fuel (AMK) may exist. Incompatibility can be due to reduced fuel system component performance with AMK or shear degradation of the AMK by the fuel system components. Survey results, to date, indicate that potential component performance problems with AMK are more significant than loss of AMK flammability protection due to shear degradation. Components of interest include ejector pumps, fuel filters, and auxiliary power units. The solubility of water in AMK and its effect on fuel system performance under actual operating conditions is also of major importance. Author (GRA)

N82-27530# Department of Energy, Bartlesville, Okla. Energy Technology Center.

LIQUID FOSSIL FUEL TECHNOLOGY Quarterly Technical Progress Report, Apr. - Jun. 1981

Oct. 1981 72 p

(DE82-004725; DOE/BETC/QPR-81/2) Avail: NTIS HC A04/MF A01

Highlights of progress made during the quarter ending June, 1981, are presented. Cation exchange capacity of oil and gas wells was determined using a semi-automated procedure. The equivalent alkane carbon number (EACN) was determined for Delaware-Childers oil. It was shown that for this oil, the type of surfactant and alcohol used causes the EACN to vary on unusual amount. Arsenic compounds from samples of Green River oil shale kerogen was identified (both inorganic and organometallic compounds). The concepts of adsorption isotherm, used for determining the thermodynamic properties of surfactant systems, has undergone some changes in order to better represent the physical model. A derivation of the new ideas and their application to immersion measurements are described. A method for analysis of alcohols in water, hydrocarbon mixtures, or exhaust gases was developed. The method, which utilizes two gas chromatographs, analyzes methanol, ethanol, and other alcohols up through the C4 group. DOE

N82-27532# Stearns-Roger Corp., Denver, Colo.

BI-GAS PILOT PLANT Quarterly Technical Progress Report, 1 Jan. - 31 Mar. 1981

1981 80 p refs

(Contract DE-AC01-80ET-14705)

(DE82-004753; DOE/ET-14705/26) Avail: NTIS HC A05/MF A01

The plant is designed to process a maximum of 5 tons per hour of coal. It is a facility designed to study all phase of coal conversion to high BTU, pipeline quality gas. This particular staged concept of gasification was originated primarily to maximize the yield of methane. Considerable methane is produced as the coal is devolatilized. DOE

N82-27534# Engineering-Science, Inc., Arcadia, Calif.

ANALYSIS OF POTENTIAL METHODS TO DETERMINE VOLATILITIES OF HEAVY CRUDE OILS Final Report

R. J. BRYAN Dec. 1981 60 p refs

(Contract EPA-68-02-3509)

(PB82-145384; EPA-909/9-81-004) Avail: NTIS HC A04/MF A01 CSCL 21D

Alternative methods to measure the volatility of heavy crude oil are discussed. The work was restricted to a literature search and inquiries made to informed government and industry groups. Methods investigated include developing data to extend the temperature and vapor pressure range of the correlation nomograph, modifying the Reid vapor pressure method, use of a

vapor composition approach, and determining evaporation losses under controlled conditions. Sampling and analytical problems were evaluated for the alternatives. A recommendation was made to conduct further studies on the vapor composition method. GRA

N82-27535# Water Resources Council, Washington, D.C.
SYNTHETIC FUELS DEVELOPMENT IN THE UPPER COLORADO REGION: SECTION 13(A) WATER ASSESSMENT REPORT
Jul. 1981 138 p refs
(PB82-153761) Avail: NTIS HC A07/MF A01 CSCL 13B

The following general conclusions and major specific findings were reached during the course of the water assessment for the Upper Colorado region. The production of synthetic fuels in the Upper Colorado River region by the extraction and processing of oil shale and/or coal, will require significant quantities of water. The overall supply of ground and surface water resources in the region is sufficient to accommodate a synthesis production level of nearly 3 million barrels oil equivalent per day. While the gross water supplies in the region are sufficient for accelerated synfuels development, water supply problems are apparent in some areas. GRA

N82-27798# Geokinetics, Inc., Salt Lake City, Utah.
INVESTIGATION OF THE GEOKINETICS HORIZONTAL IN SITU OIL SHALE RETORTING PROCESS Quarterly Report, Jul. - Sep. 1981
J. R. GILBERT Nov. 1981 30 p refs
(Contract DE-FC20-78LC-10787)
(DE82-004273; DOE/LC-10787/86) Avail: NTIS HC A03/MF A01

The development of an in-situ process for recovering shale oil is reported. A retort No. 26 was loaded with explosives on August 5 and 6. On August 7, retort No. 26 was detonated. The retort No. 26 blast was was highly successful. Following the blast of retort No. 26 preparations are made for the ignition of retort No. 25. Equipment and piping were set in place and the instrumentation systems were wired in. Ignition for retort No. 25 is scheduled for mid to late October 1981. The retort No. 26 Postblast coring program continues. With the ignition of retort No. 25 the anaytical lab began constant monitoring of the retort burn. DOE

N82-27801# Engineers International, Inc., Downers Grove, Ill.
INVESTIGATION OF PROBLEMS AND BENEFITS OF UNDERGROUND MULTIPLE SEAM COAL MINING Final Technical Report
M. M. SINGH and M. F. DUNN Washington DOE Oct. 1981 325 p refs
(Contract DE-AC01-79ET-14242)
(DE82-002807; DOE/ET-14242/T2) Avail: NTIS HC A14/MF A01

It is estimated that over 156 billion tons of coal in the United States are amenable to multiple-seam mining. However, currently most operations mine only a single seam, and in the past indiscriminate practices have sterilized large amounts of coal in contiguous seams. In the interests of conservation, it is imperative that procedures be followed that enhance resource recovery. The total life-cycle costs of mining are site specific because of the wide variations in land acquisition costs, capital expenditures, resource recovery, labor productivity, and geological conditions. However, under similar circumstances the costs of single- and multiple-seam mining are within 5 percent, using the best available technology. Improvements in present methods could lower costs of multiple-seam mining further, making it more competitive. Ground control (entailing roof support, bumps, and subsidence) is the most important technical problem encountered in multiple-seam mining, mainly caused by remnant pillars. DOE

N82-27804# Western Geophysical Co. of America, Houston, Tex. Aero Service Div.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY: NORTH/SOUTH TIELINE, VOLUME 1 Final Report
May 1981 38 p refs 2 Vol.
(Contract DE-AC13-76GJ-01664)
(DE82-005542; GJBX-386-81-VOL-1) Avail: NTIS HC A03/MF A01

An airborne high sensitivity gamma ray spectrometer and magnetometer survey was conducted along the 990 longitude meridian from the Canadian border southward to the Mexican border. A total of 1555 line miles of geophysical data were acquired. The program acquires and compiles geologic and other information to assess the magnitude and distribution of uranium resources and to determine areas favorable for the occurrence of uranium in the United States. DOE

N82-27805# Western Geophysical Co. of America, Houston, Tex. Aero Service Div.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY: NORTH/SOUTH TIELINE, VOLUME 2 Final Report
May 1981 108 p refs 2 Vol.
(Contract DE-AC13-76GJ-01664)
(DE82-005570; GJBX-386-81-VOL-2) Avail: NTIS HC A06/MF A01

Data from an airborne high sensitivity gamma-ray spectrometer and magnetometer sur ey along the 990 longitude meridian from the Canadian border southward to the Mexican border are presented. The purpose of this study is to acquire and compile geologic and other information with which to assess the magnitude and distribution of uranium resources and to determine areas favorable for the occurrence of uranium in the US. DOE

N82-27808# Texas Univ., El Paso. Dept. of Geological Sciences.
EVALUATION AND COMBINED GEOPHYSICAL INTERPRETATIONS OF NURE AND RELATED GEOSCIENCE DATA IN THE VAN HORN, PECOS, MARFA, FORT STOCKTON, PRESIDIDO, AND EMORY PEAK QUADRANGLES, TEXAS, VOLUME 1 Final Report
G. R. KELLER, W. J. HINZE, C. L. V. AIKEN, P. C. GOODELL, R. F. ROY, and N. E. PINGITORE Sep. 1981 451 p refs 2 Vol.
(Contract DE-AC13-76GJ-01664)
(DE82-005554; GJBX-365-81) Avail: NTIS HC A20/MF A01

The six Trans-Pecos Texas quadrangles (Van Horn, Pecos, Marfa, Port Stockton, Presidio, and Emory Park) were surveyed. The aeromagnetic gravity and geochemical data, their processing, and their analysis are discussed. The geologic history and setting of the Trans-Pecos are discussed along with the uranium potential of the region. Uranium anomalies and occurrences are present in the study area, and information is presented on 33 drill holes into these targets. A folio of maps reduced to a scale of 1:500,000. Geologic maps for each of the six quadrangles are included and the geophysical maps have been prepared to be overlays for the geologic maps. Residual aeromagnetic anomaly, complete Bougner gravity anomaly, flight line index, gravity station index, and anomaly interpretative maps were prepared for each quadrangle. A large suite of digitally processed maps of gravity and aeromagnetic are included. DOE

N82-27829# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
A PROGRAM FOR SINGLE-PHASE MODERATE-TEMPERATURE GEOTHERMAL WELL DRAWDOWN AND PUMPING ENERGY FOR THE HP-97 AND OTHER DESK CALCULATORS
K. YU and R. VONBRIESEN Nov. 1981 18 p refs
(Contract DE-AI01-79ET-27025; EX-76-A-1008)
(PB82-148420; JHU/APL/QM-81-138) Avail: NTIS HC A02/MF A01 CSCL 08I

A desk calculator program was developed to provide a simple hydrologic model that could be used by those interested in the preliminary sizing of withdrawal rates and schedules for geothermal wells. The program was of considerable use in technical assistance projects along the Atlantic Coastal Plain. The program output is in the form of a listing that shows the incrementation years with the appropriate drawdown and the total pumping energy for each year. GRA

N82-27834# Dunn Geoscience Corp., Latham, N.Y.
ANALYSIS OF POTENTIAL GEOTHERMAL RESOURCES AND THEIR USE: LEBANON SPRINGS, NEW YORK
J. R. DUNN and W. E. CUTCLIFFE Apr. 1981 59 p
(PB82-147380; NYSERDA-81-4) Avail: NTIS HC A04/MF A01 CSCL 08G

In addition to geologic mapping of the Lebanon Springs area and Williamstown, Massachusetts area, thermal gradients were measured in 25 abandoned water wells in the area. The silica content and water temperatures of 78 active domestic water wells were determined. T.M.

N82-27841# Sandia Labs., Albuquerque, N. Mex.
GEOTHERMAL POTENTIAL ON KIRTLAND AIR FORCE BASE LANDS, BERNALILLO COUNTY, NEW MEXICO
P. R. GRANT, JR. (Energy Resources Exploration, Inc.) Oct. 1981 65 p refs
(Contract DE-AC04-76DP-00789)
(AD-A107044; SAND-81-7141) Avail: NTIS HC A04/MF A01 CSCL 08H

Public policy expressed in a number of national directives in recent years stresses the conservation of conventional fuel supplies, a switch to alternative fuels, and the application of advanced energy technologies at federal installations. Natural gas currently furnishes 85 to 95 percent of the average 94 x 1,000,000 Btu/hr energy requirements for space heating and cooling at Kirtland Air Force Base. Studies of alternatives to the use of natural gas at the base include examination of the geothermal option. Four of North America's major physiographic provinces coalesce in central New Mexico on or near Kirtland AFB. Their junction is identified throughout much of this region by a tectonic depression occupied by the Rio Grande that is structurally complex, stratigraphically and hydrologically unique, and coincides with geologically recent volcanic centers. This trough, the Rio Grande rift, has been identified as a major geothermal resource area. The western part of Kirtland AFB is in the Albuquerque Basin segment of the Rio Grande rift. Extensive sampling and geochemical analysis of groundwater in and near the base disclosed no significant geothermal parameters. However, structural conditions and current hydrologics regimes strongly suggest that thermal waters would be masked by near surface, low temperature meteoric water originating as rain and snowfall in the nearby mountains. GRA

N82-27857# Bayerisches Landesamt fuer Wasserwirtschaft (West Germany).
INVESTIGATION INTO THE ECONOMY OF METHANE GAS UTILIZATION IN SEWAGE TREATMENT PLANTS Final Report
P. WOLF Bonn Bundesministerium fuer Forschung und Technologie Mar. 1982 154 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-025; ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 32

The economic feasibility of methane gas utilization in small and medium sized sewage treatment plants was studied. Assuming that rising energy costs make this energy source attractive, existing and theoretical model plants of various sizes were investigated by considering different price scales for electric power and fuel oil. This was done with variation of the kind of biological sewage treatment, sludge treatment, and of kinds and facilities of methane gas utilization. Results show that using methane gas for power generation is relatively economic in comparison to alternative methods of gas utilization for treatment plants bigger than 50,000 population equivalent. Author (ESA)

N82-27859# Pacific Northwest River Basins Commission, Vancouver, Wash.
WATER AND EMERGING ENERGY TECHNOLOGIES: SUMMARY REPORT
Mar. 1981 106 p Sponsored in part by Water Resources Council, Washington, D.C.
(PB82-153123) Avail: NTIS HC A06/MF A01 CSCL 13B

An assessment of possible energy development in structural basins of the Pacific Northwest is presented. The energy technologies examined include small hydro, geothermal electric, geothermal heat, biomass/cogeneration, and coal gasification. T.M.

N82-27860# Pacific Northwest River Basins Commission, Vancouver, Wash.
WATER AND EMERGING ENERGY TECHNOLOGIES
Mar. 1981 139 p Sponsored in part by Water Resources Council, Washington, D.C.
(PB82-153131) Avail: NTIS HC A07/MF A01 CSCL 13B

In 1977, the Department of Energy requested that the Water Resources Council undertake the required assessments whereupon development of Section 13(a) assessments were begun in the Missouri River, Ohio River, and upper Colorado River Basins. In September 1979, a Memorandum of Agreement between the Water Resources Council and Pacific Northwest River Basins Commission initiated an assessment in the Pacific Northwest. This report documents the findings and conclusions of that 13(a) assessment are presented. GRA

N82-27884# Conference of Radiation Control Program Directors, Inc., Rockville, Md.
NATURAL RADIOACTIVITY CONTAMINATION PROBLEMS Final Report
Sep. 1981 134 p refs Prepared in cooperation with Nuclear Regulatory Commission
(Contract PHS-223-79-6010; EPA-IAG-D7-0968)
(PB82-140443; NCRCPD-1; FR-2) Avail: NTIS HC A07/MF A01 CSCL 18H

Levels of naturally occurring radionuclides associated with the bauxite, columbium-tantalum, phosphate, tin, pumice, and titanium mineral extraction industries are reported. Data is also presented on radioactivity measurements in ground water, in selected geothermal waters, and in oil production brines. Radiation protection guidance is provided for uranium recovery from wet-process phosphate plants, for soil contamination limits, and for radiological exposure in natural caves. Dose pathways from incidental uses of naturally occurring radioactive materials are presented. Model state regulations for protecting public health and safety from use and disposal of naturally occurring radioactive material are outlined. GRA

N82-27909# Geological Survey, Reston, Va. Office of Energy Resources.
SHALE CHARACTERIZATION AND RESOURCE APPRAISAL OF DEVONIAN BLACK SHALES OF THE APPALACHIAN BASIN Monthly Report for October 1981
W. DEWITT, JR. Oct. 1981 12 p
(Contract DE-AI21-79MC-10866)
(DE82-004191; DOE/MC-10866/T10) Avail: NTIS HC A02/MF A01

Department of Energy funds for the US Geological Survey's characterization and approval program were exhausted. Final reports for 4 of the 9 projects of the program were released to

METC during FY 1981. Monthly progress reports will continue to be submitted to DOE until the last of the program work is completed and the last of the project final reports submitted to METC.

DOE

05

ENERGY CONVERSION

Includes thermomechanical, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reactors, magnetohydrodynamic generators, and fuel cells.

A82-28587
THE GAS TURBINE ENGINE
D. DRIVER, D. W. HALL, and G. W. MEETHAM (Rolls-Royce, Ltd., Derby, England) In: The development of gas turbine materials. London, Applied Science Publishers, 1981, p. 1-30. refs

An historical account is given of the developments in gas turbine engine mechanical design which, by increasing operating temperature requirements in their evolution towards greater thrust and lower fuel consumption, have strongly affected the choice of component materials. The desire to reduce powerplant weight, and especially the weight of rotating components, has also been a significant factor in the development of materials. Compressor materials, which were largely aluminum alloy in the earliest gas turbine engines, were supplanted by steels as temperatures rose above 200 C in the early 1950s; the development of high specific strength titanium alloys led to their application to compressor blades and casings after 1960. Combustion chamber and turbine materials have been a succession of increasingly corrosion-resistant nickel-based superalloys. Attention is also given to drive shafts and bearings. O.C.

A82-29070#
APPROACH TO THE REALIZATION OF A CLOSED CYCLE OCEAN THERMAL ENERGY CONVERSION /OTEC/ SYSTEM
T. KAJIKAWA Electrotechnical Laboratory, Researches, no. 206, Aug. 1981. 225 p. In Japanese, with abstract in English. refs

The design and operational features and goals of a Japanese 1 MWe Ocean Thermal Energy Conversion (OTEC) demonstration plant are described. Japan research and development efforts in OTEC systems are reviewed, along with results which have encouraged the decision to construct the demonstration plant. The plant is being designed for implementation in the seas around Japan, is required to function for 6 mos/yr, and will provide engineering data on the performance of both tube and shell type heat exchangers. The initial test will be run using Freon 22 as the working fluid, followed by NH3 in subsequent trials. The system will be barge-mounted and have a cooling water pipe fixed by single-point mooring. Mainly a proof of principle in large-scale OTEC, the plant will provide a test bed for environmental monitoring and power transmission through the sea, and will serve as a model for a 10 MWe plant. M.S.K.

A82-29738
ALFVEN-WAVE GENERATION IN A BEAM-PLASMA SYSTEM
P. K. SHUKLA (Bochum, Ruhr-Universitaet, Bochum, West Germany) and R. P. SHARMA (Bochum, Ruhr-Universitaet, Bochum, West Germany; Indian Institute of Technology, New Delhi, India) Physical Review A - General Physics, 3rd Series, vol. 25, May 1982, p. 2816-2819. refs

This paper considers nonlinear decay of a beam-driven plasma mode into an Alfven wave plus a circularly polarized electromagnetic wave near the electron-plasma frequency. Explicit expressions for the growth rate and threshold are obtained analytically. Relevance of our work to space as well as laboratory plasmas is discussed. (Author)

A82-29793
FUTURE AUTO ENGINES - COMPETITION HEATS UP
C. RAIN High Technology, vol. 2, May-June 1982, p. 39-47.

The conventional internal combustion engine will remain an important factor in future automobile engines because it is perfectly suited to the widely varying conditions of city and highway driving, and engineers continue to eke out design advances. Diesels will continue to make strong gains in the near term because of their fuel economy advantage, but their emissions and fuel requirement problems are serious. Stratified charge engines could challenge the diesel because they satisfy governmental goals and would require the lowest retooling costs. Their multifuel capability gives them long-term viability. The gas turbine and the Stirling offer the best fuel economies and are clean-burning, and both run on a wide range of fuels. The Stirling requires engineering to improve its power density and to cut costs, while the gas turbine needs a breakthrough in durable high-temperature ceramics. C.D.

A82-30331
ENERGY RELATED OPTICAL COATINGS
A. THELEN (Optical Coating Laboratory, Inc., Santa Rosa, CA) Journal of Vacuum Science and Technology, vol. 20, Mar. 1982, p. 310-315. refs

Current applications of optical coatings to improve the efficiency of energy conversion are reviewed. Conversion both into optical energy (energy efficient lighting, regenerative lamps) and from optical energy (architectural coatings, for photothermal and photovoltaic converters, laser fusion coatings) is discussed. The impact of advanced roll coating technology is assessed.

(Author)

A82-30866
ON THE SPECTRAL ENERGY AND POWER COMPONENTS IN HORIZONTAL WIND GUSTS
P. R. BARKER and G. J. BOWDEN (New South Wales, University, Kensington, Australia) Wind Engineering, vol. 6, no. 1, 1982, p. 1-11. refs

A82-30868
POWER OPTIMIZATION OF WIND ELECTRIC CONVERSION SYSTEMS INTEGRATED INTO THE UTILITY GRID
K. KALAITZAKIS and G. VACHTSEVANOS (Thrace, University, Xanthe, Greece) Wind Engineering, vol. 6, no. 1, 1982, p. 24-36. refs

A82-30869
A FREQUENCY AND DURATION METHOD FOR THE EVALUATION OF WIND INTEGRATION
A. J. JANSSEN (Netherlands Energy Research Foundation-ECN, Petten, Netherlands) Wind Engineering, vol. 6, no. 1, 1982, p. 37-58. refs

The theory and extent of applicability of a frequency and duration (FD) method for reliability and energy production studies of wind-assisted utility power systems are detailed. Inputs to the FD are the frequencies and durations of system load levels and forced outages of the production units, which are ranked from base to peak loads. Scheduled down times are added to the calculations to form a model for a perfectly reliable system of units subjected to a random load. An algorithm is developed for evaluation of the effective load, and uncertainties in predictions of annual peak loads are included. A two-state Markov model for the production units is presented and a generalization for multistage generators is made for cases when correlations do and do not exist in the temporal variability of the system load and the intermittent wind energy source. The limited operating flexibility of the wind turbines indicates that some thermal power capacity be given priority as base load units while large scale windfarm development may result in the reduction of the total number of base load plants and an increase in the number of peaking plants. M.S.K.

A82-31572
RELIABILITY ANALYSIS OF COMBINED WIND-ELECTRIC AND CONVENTIONAL GENERATION SYSTEMS
R. G. DESHMUKH (Memphis State University, Memphis, TN) and R. RAMAKUMAR (Oklahoma State University, Stillwater, OK) Solar Energy, vol. 28, no. 4, 1982, p. 345-352. Research supported by the Oklahoma State University and Memphis State University. refs

Probabilistic models for wind-electric conversion systems and their use in the reliability studies of combined wind-electric and conventional generation systems are discussed. Representative numerical results for a typical site in Hawaii for the month with an excellent wind regime are presented. The results and discussions documented in this paper should be helpful in the planning and incorporation of wind-electric systems as a component in the generation mixes of the utility systems of the future. (Author)

A82-31843
THE THERMODYNAMICS OF ELECTROLYTE DISTRIBUTION IN MOLTEN CARBONATE FUEL CELLS
R. H. ARENDT (GE Physical Chemistry Laboratory, Schenectady, NY) Electrochemical Society, Journal, vol. 129, May 1982, p. 942-946. refs

The fundamental thermodynamic relations governing the behavior of a fluid phase residing within the interstices of a porous solid phase are reviewed. The relationships are applied to the problem of electrolyte distribution among the components of the molten carbonate fuel cell. This distribution is of paramount importance in determining cell electrochemical performance. In addition, the function of the electrolyte structure, or 'tile,' as a gas impermeable partition between the anode and cathode environment is considered. (Author)

A82-31844
ALTERNATE MATRIX MATERIAL FOR MOLTEN CARBONATE FUEL CELL ELECTROLYTE STRUCTURES
R. H. ARENDT (GE Physical Chemistry Laboratory, Schenectady, NY) (Electrochemical Society, Meeting, Hollywood, FL, Oct. 5-10, 1980.) Electrochemical Society, Journal, vol. 129, May 1982, p. 979-983. refs
(Contract DE-AC03-77ET-11319)

The preparation and physicochemical characteristics of $SrTiO_3$ crystallites suitable for use as the matrix for liquid alkali carbonates in fuel cells are presented. The preparation utilizes a fugitive molten alkali chloride solvent to effect product formation. The product, following separation from the reaction medium, is composed of submicron, relatively uniformly shaped and sized, monodispersed crystallites. Data are presented on the utilization of this material in both hot-pressed and impregnation fabricated electrolyte structures. Data from the preliminary fuel cell evaluation of such structures are also presented. (Author)

A82-31876*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE ALKALI METAL THERMOELECTRIC CONVERTER /AMTEC/ - A NEW DIRECT ENERGY CONVERSION TECHNOLOGY FOR AEROSPACE POWER
C. P. BANKSTON, T. COLE, R. JONES, and R. EWELL (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 10 p. refs
(Contract NAS7-100)
(AIAA PAPER 82-0862)

A thermally regenerative electrochemical device for the direct conversion of heat to electrical energy, the alkali metal thermoelectric converter (AMTEC), is characterized by potential efficiencies on the order of 15-40% and possesses no moving parts, making it a candidate for space power system applications. Device conversion efficiency is projected on the basis of experimental voltage vs current curves exhibiting power densities of 0.7 W/sq cm and measured electrode efficiencies of up to 40%. Preliminary radiative heat transfer measurements presented may be used in an investigation of methods for the reduction of AMTEC parasitic radiation losses. AMTEC assumes heat input and rejection temperatures of 900-1300 K and 400-800 K, respectively. The working fluid is liquid sodium, and the porous electrode employed is of molybdenum. O.C

A82-31910#
SIMULATION OF THE START-UP TRANSIENT RESPONSES OF THE UTSI COAL-FIRED MHD POWER GENERATING SYSTEM
Y. F. LIAO, M. ISHIKAWA, H. J. SCHMIDT, and T. C. L. WU (Tennessee, University, Tullahoma, TN) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 12 p. refs
(Contract DE-AC02-79ET-10815)
(AIAA PAPER 82-0920)

A numerical procedure for solving the unsteady, two-dimensional, compressible Navier-Stokes equations has been extended for MHD flows by the inclusion of the appropriate Lorentz force and Joule heating terms in the governing equations. With appropriate initial and boundary conditions, the procedure can be used for the investigation of transient phenomena as well as the asymptotic steady-state characteristics of internal MHD flows. Results obtained for the simulation of starting processes in the UTSI (University of Tennessee Space Institute) coal-fired MHD flow train are presented and found to be in good agreement with experimental observations. (Author)

A82-31911#
FAULT ANALYSIS OF MID-CHANNEL POWER TAKEOFF IN DCW MHD GENERATORS
M. ISHIKAWA, Y. C. L. WU, and M. H. SCOTT (Tennessee, University, Tullahoma, TN) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 9 p. refs
(Contract DE-AC02-79ET-10815)
(AIAA PAPER 82-0922)

Analysis is presented of the effect of loading faults on the mid-channel power takeoff of a diagonal-conducting-wall MHD generator in special loading schemes. Two-dimensional calculations indicate that an open-circuit condition in the upstream load circuit results in a large current density at the power takeoff anode and drives a shorting current over the interframe insulators at the cathode side. A short-circuit condition in the upstream load circuit results in a large current density at the power takeoff cathode and a shorting current over the interframe insulators at the anode side. V.L.

A82-31912#
INTERACTION BETWEEN MHD GENERATOR AND DC-AC POWER CONVERSION SYSTEM
D. TANAKA (Niihama Technical College, Niihama, Ehime, Japan) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 8 p. refs
(AIAA PAPER 82-0923)

Transient characteristics of an MHD power generating system including a DC-AC inverter are analyzed using a time-dependent quasi-one-dimensional approximation. The generator model considered is Faraday type of U-25 class with heavy-oil and air combustion gas. It is found that a short-circuited fault of the invertor may become more serious than an open-circuited fault, resulting in significant gas velocity reduction. An open-circuited fault, if retained for more than 5-8 ms, can substantially increase the gas velocity at the upstream end of the fault region. A protection system composed of a fast-acting DC circuit-breaker and an emergency load resistance is proposed. The switching speed of the DC breaker must be about 500 microsec to stop a pressure

increase, resulting, for example, from the short-circuiting of 20 electrode pairs, before it reaches 120% of the initial level. V.L.

A82-31947*# Oklahoma State Univ., Stillwater.
MODELING PARAMETER INFLUENCES ON MHD SWIRL COMBUSTION NOZZLE DESIGN
D. G. LILLEY (Oklahoma State University, Stillwater, OK), A. K. GUPTA (MIT, Cambridge, MA), and A. A. BUSNAINA American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 10 p. refs
(Contract DE-QC01-79ET-15518; NAG3-74)
(AIAA PAPER 82-0984)

Attention is given to a research project which has the goal to develop a two-stage slagging gasifier-combustor in the form of a high-intensity combustor, taking into account a suitable aerodynamic design of the second stage nozzle which will prevent the separation of the boundary layer as the flow turns from axial to radial direction. The specific objectives of the present investigation are to test the effect of various second-stage nozzle geometries, flow rates, swirl number, and distribution in the first and second stages upon the corresponding flowfield in the second stage. Special emphasis is given to the avoidance of boundary layer separation as the flow turns from axial to radial direction into the MHD disk generator. G.R.

A82-32331
SALINITY-GRADIENT VAPOR-PRESSURE POWER CONVERSION
M. S. OLSSON (California, University, La Jolla, CA) Energy (UK), vol. 7, Mar. 1982, p. 237-246. Research supported by the University of California and Foundation for Ocean Research. refs

The interface between water bodies of different salinities represents a large unexploited source of energy. An energy conversion approach that does not require the use of membranes but uses the differences in vapor pressure between solutions is examined. The resource potential, source solutions, system components, and operating characteristics are evaluated and, where similar, compared to research and development on open-cycle OTEC (Ocean Thermal Energy Conversion). It is shown that salinity-gradient, vapor-pressure power generation is within reach of current technology. (Author)

A82-32372
EFFICIENCIES OF HEAT ENGINES AND FUEL CELLS - THE METHANOL FUEL CELL AS A COMPETITOR TO OTTO AND DIESEL ENGINES
R. W. GLAZEBROOK (Shell Research, Ltd., Thornton Research Centre, Chester, England) Journal of Power Sources, vol. 7, Mar. 1982, p. 215-256. refs

As the real cost of fuel rises the efficiency of energy conversion devices will become of increasing importance. Efficiency is a variable factor depending inter alia on load factor. Whereas heat engines commonly yield optimum efficiencies at near to maximum power, fuel cells yield optimum efficiencies at zero power. Projections based on realistic developments suggest that fuel cells will operate overall with higher efficiencies than heat engines when load factors are below approximately 45%. Road transportation generally operates at load factors much lower than this and represents a suitable market for fuel cells. (Author)

A82-32566#
LARGE AREA, HIGH SPEED DETECTORS FOR THE ULTRAVIOLET
S. C. STOTLAR, E. J. MCLELLAN, and C. R. JONES (Los Alamos National Laboratory, Los Alamos, NM) In: Los Alamos Conference on Optics '81, 2nd, Los Alamos, NM, April 7-10, 1981, Proceedings. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p. 421-425. Research sponsored by the U.S. Department of Energy.

Pyroelectric detectors are a type of energy sensor which provides broadband spectral operation, six-decade linearity and simplicity of application. It is shown that detectors of strontium barium niobate and lithium tantalate are the most useful in the family of pyroelectric materials for UV applications, with response times that range from below 100 picosec to 1 sec. The design of appropriate UV detectors requires characterization of a given pyroelectric substance's pulse damage threshold and the examination of surface preparation techniques. O.C.

A82-32760
THE PROBABILITY DISTRIBUTION OF WIND POWER FROM A DISPERSED ARRAY OF WIND TURBINE GENERATORS
J. CARLIN (Commonwealth Scientific and Industrial Research Organization, Div. of Mathematics and Statistics, Canberra, Australia) and J. HASLETT (Trinity College, Dublin, Ireland) Journal of Applied Meteorology, vol. 21, Mar. 1982, p. 303-313. Research supported by the National Energy Research, Development and Demonstration Council of Australia. refs

A method is presented for estimating the probability distribution of wind power from a dispersed array of wind turbine sites where the correlation between wind speeds at distinct sites is less than unity. The distribution is obtained from a model for the joint probability distribution of wind speeds. This is able to incorporate arbitrary inter-site correlations. It is shown that this joint distribution reduces in the single site case to a wind speed distribution closely approximating the widely used Weibull; the multiple site power distribution is also shown to fit adequately to data on wind speeds from four sites in Western Australia. Results presented in graphical and tabular form for a range of representative cases show that a significant reduction in the variability of total wind power output may result from dispersion of aerogenerator sites; a quantitative guide to the magnitude of these effects is also provided. (Author)

A82-32772
WIND POWER AS AN ELECTRICAL ENERGY SOURCE IN ILLINOIS
W. M. WENDLAND (Illinois State Water Survey, Dept. of Energy and Natural Resources, Champaign, IL) Journal of Applied Meteorology, vol. 21, Mar. 1982, p. 423-428.

A preliminary estimate of the total wind power available in Illinois was made using available historical data, and projections of cost savings due to the presence of wind-generated electricity were attempted. Wind data at 10 m height were considered from nine different sites in the state, with three years data nominally being included. Wind-speed frequency histograms were developed for day and night periods, using a power law function to extrapolate the 10 m readings to 20 m. Wind speeds over the whole state were found to average over 8 mph, the cut-in point for most wind turbines, for from 40-63% of the time. A maximum of 75% run-time was determined for daylight hours in April-May. A reference 1.8 kW windpowered generator was used in annual demand projections for a reference one family home, using the frequency histograms. The small generator was projected to fulfill from 25-53% of the annual load, and, based on various cost assumptions, exhibited paybacks taking from 14-27 yr. M.S.K.

A82-33397
OPTIMIZATION OF THE OPERATION OF A WIND POWER PLANT [OPTIMIZATSIIA REZHIMA RABOTY VETROSILOVOI USTANOVKI]
A. D. MUZYCHENKO and V. V. PSHENICHNYI (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR) In: Methods and technical tools for current stabilization (Metody i tekhnicheskie sredstva stabilizatsii toka). Kiev, Izdatel'stvo Naukova Dumka, 1980, p. 119-125. In Russian. refs

The paper proposes an optimal design scheme for a wind powerplant, whereby, in the case of variable wind velocity, maximum power extraction corresponding to this variable velocity is achieved. The optimal design must include a voltage-source to current-source converter between the aerogenerator and the buffer battery, and the control of the generator must provide for nonlinear feedback with respect to the rotation velocity of the aerogenerator shaft. B.J.

A82-33701
BIENNIAL WIND ENERGY CONFERENCE AND WORKSHOP, 5TH, WASHINGTON, DC, OCTOBER 5-7, 1981, PROCEEDINGS
ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, May 1982. 74 p.

The results of studies funded by the Federal government to advance the state of the art of wind energy conversion systems (WECS) construction, operation, applications, and financial viability are presented. The economics of WECS were considered in terms of applicable tax laws, computer simulations of net value of WECS to utilities, and the installation of Mod-2 2.5 MW and WTS-4 4MW wind turbines near Medicine Bow, WY to test the operation of two different large WECS on the same utility grid. Potential problems of increasing penetration of WECS-produced electricity on a utility grid were explored and remedies suggested. The structural dynamics of wind turbines were analyzed, along with means to predict potential noise pollution from large WECS, and to make blade fatigue life assessments. Finally, Darrieus rotor aerodynamics were investigated, as were dynamic stall in small WECS and lightning protection for wind turbines and components.
M.S.K.

A82-33702#
STRATEGIES FOR MINIMIZING OPERATIONAL IMPACTS OF LARGE WIND TURBINE ARRAYS ON AUTOMATIC GENERATION CONTROL SYSTEMS
T. W. REDDOCH, P. R. BARNES (Oak Ridge National Laboratory, Oak Ridge, TN), J. S. LAWLER (Tennessee, University, Knoxville, TN), and J. C. SKROSKI (Atlantic City Electric Co., Atlantic City, NJ) (Biennial Wind Energy Conference and Workshop, 5th, Washington, DC, Oct. 5-7, 1981.) ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, May 1982, p. 65-69. refs
(Contract W-7405-ENG-26)

A primary application of wind electric generation is expected to be large clusters or arrays of MW-size wind turbines connected to the utility transmission network. Array output power variations due to the uncontrolled nature of the wind resource can cause undesirable dynamic impacts on the utility system, such as excessive frequency and/or tie-line power flow deviations. As a consequence, spinning reserve, unloadable generation, and load following requirements and their associated economic penalties tend to increase as wind electric generation is added to the system. However, if array power variations are limited and/or anticipated, the associated operation and economic penalties can be significantly reduced. In this paper, a number of operational concepts are considered which have the potential to enhance the effectiveness of wind turbine arrays in the utility system.
(Author)

A82-33703#
WIND SYSTEM VALUE ANALYSIS FOR ELECTRIC UTILITIES - A COMPARISON OF FOUR METHODS
J. HARPER, D. PERCIVAL, T. FLAIM (Solar Energy Research Institute, Golden, CO), and R. L. SULLIVAN (Florida, University, Gainesville, FL) (Biennial Wind Energy Conference and Workshop, 5th, Washington, DC, Oct. 5-7, 1981.) ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, May 1982, p. 70-76.
(Contract EG-77-C-01-4042)

A comparison and suggestions for improvements in the SERI-H, SERI Weibull, AERO, and JBF value models for estimation of the economic worth of wind energy conversion systems (WECS) to utilities are made. The simulations comprise projections for operations with and without WECS, fuel, operation, and maintenance costs, base load and generating capacity, reliability, estimated WECS performance, wind resource, fuel escalation rates, and scenarios with pumped hydro storage. The Weibull curve was found to be good in the SERI-H model only for considering winds above cut-in. Reasonable agreement was found at the 5% peak load penetration level for all models. Installing 635 MW of WECS was determined to replace from 126-177.9 MW of conventional utility generator capacity. The breakeven value for Mod 2 installation was determined at $1620/kW for use in southern California and $1850-2470/kW in Michigan.
M.S.K.

A82-33704#
MEDICINE BOW WIND PROJECT
L. L. NELSON (U.S. Bureau of Reclamation, Denver, CO) (Biennial Wind Energy Conference and Workshop, 5th, Washington, DC, Oct. 5-7, 1981.) ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, May 1982, p. 77-83.

The Bureau of Reclamation (Bureau) conducted studies for a wind turbine field of 100 MW at a site near Medicine Bow, WY, one of the windiest areas in the United States. The wind turbine system would be electrically interconnected to the existing Federal power grid through the substation at Medicine Bow. Power output from the wind turbines would thus be integrated with the existing hydroelectric system, which serves as the energy storage system. An analysis based on 'willingness to pay' was developed. Based on information from the Department of Energy's Western Area Power Administration (Western), it was assumed that 90 mills per kWh would represent the 'willingness to pay' for onpeak power, and 45 mills per kWh for offpeak power. The report concludes that a 100-MW wind field at Medicine Bow has economic and financial feasibility. The Bureau's construction of the Medicine Bow wind field could demonstrate to the industry the feasibility of wind energy.
(Author)

A82-33750
THE TM 333, A TRUMP CARD FOR TURBOMECA [LE TM 333, ATOUT MAJEUR DE TURBOMECA]
J. MORISSET Air et Cosmos, vol. 20, May 8, 1982, p. 13, 15-17. In French.

The new dual turbine, digital control TM 333 helicopter motor is described as having benefitted from a ten year program in basic aerodynamics, metallurgy, and electronics research. High compression, high expansions in reverse flow digitally controlled engines are coupled with improvements in the gear reductions and joints. The helicopter achieves program goals set in July 1979 of low operating cost, efficient fuel consumption over a broad power range, modular maintenance, fewer parts and lower purchase price, and low specific weight. The power plant furnishes a take-off impulse of 625 kW with a continuous output of 560 kW, with a fuel consumption of 318-330 gr/kWh. Specific performance features are listed and comparisons are made with turbines of other manufacturers.
M.S.K.

A82-33996
THE DEVELOPMENT OF MHD ENERGY CONVERSION METHODS IN THE USSR
V. A. KIRILLIN and A. E. SHEINDLIN (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR) Indian Academy of Sciences, Proceedings, Section C: Engineering Sciences, vol. 4, Dec. 1981, p. 405-417. refs

It is noted that the development of magnetohydrodynamic (MHD) power conversion systems has evolved to the point where it is possible to commercially introduce MHD power plants into industry. Even with the present level of technology, the sharp increase in thermal efficiency of these plants by as much as 50-60% results in fuel economies of 20-35% and in reductions in generation costs of 6-7%. A description is given of an MHD power plant and its various aggregates. Also given are a review of the state of the art of MHD technology and an outline of the Soviet program for its commercial exploitation. The design of MHD electrical power plants, the interrelation between various aggregates, and the problems arising from nonstandard equipment are discussed.
C.R.

A82-34488
SAIL-TYPE WIND-TURBINES - A REVIEW AND ANNOTATED BIBLIOGRAPHY
P. D. FLEMING and S. D. PROBERT (Cranfield Institute of Technology, Cranfie55, Beds., England) Applied Energy, vol. 10, Apr. 1982, p. 273-286. Research supported by the Science Research Council of England.

A82-34521
OPTIMIZATION OF THE REGION OF INVERSE CONVERSION IN A CYCLOTRON MICROWAVE CONVERTER [OB OPTIMIZATSII OBLASTI OBRATNOGO PREOBRAZOVANIIA TSIKLOTRONNOGO SVCH-KONVERTORA]
B. F. BUNIMOVICH, K. V. GRECHUSHKIN, V. V. GURZO, V. N. PROKUSHKIN, and V. S. STALMAKHOV Radiotekhnika i Elektronika, vol. 27, May 1982, p. 1004-1008. In Russian. refs

Nonrelativistic equations of electron motion in varying magnetic and electric fields in a thin-sphere segment are presented. An analysis is given of the geometry-optimization of a collector with the aim of increasing the efficiency of inverse conversion in microwave converters (such as those planned for systems involving microwave power transmission from satellite solar power stations to earth). It is shown that high efficiency of the inverse-conversion region can be achieved at lengths of magnetic-field variation that are much greater than the cyclotron wavelength. This approach is particularly applicable to converters with plane-symmetric magnetic-field reversal. B.J.

A82-34522
NUMERICAL SIMULATION OF RECOVERY PROCESSES IN A CYCLOTRON CONVERTER [CHISLENNOE MODELIROVANIE PROTSESSOV REKUPERATSII V TSIKLOTRONNOM PREOBRAZOVATELE]
I. M. BLEIVAS, V. A. VANKE, L. M. RYBNIKOVA, and V. L. SAVVIN Radiotekhnika i Elektronika, vol. 27, May 1982, p. 1009-1013. In Russian. refs

An axisymmetric electron-beam model is used in a numerical analysis of recovery processes in a cyclotron converter of microwave oscillations into direct current (such as that planned for satellite solar power systems). Secondary electrons emitted from the surfaces of the collector electrodes are taken into account. The spatial distribution of electric and magnetic fields in the collector cavity which provides for a recovery of 94 percent of the energy of the longitudinal motion of the electron beam is determined. B.J.

A82-34523
GROUND-BASED RECEIVING-CONVERTING COMPLEX FOR SATELLITE SOLAR POWER SYSTEMS [O NAZEMNOM PRIEMNO-PREOBRAZUIUSHCHEM KOMPLEKSE SOLNECHNYKH KOSMICHESKIKH ENERGOSISTEM]
V. A. VANKE, V. M. LOPUKHIN, V. K. ROSNOVSKII, V. L. SAVVIN, and K. I. SIGORIN Radiotekhnika i Elektronika, vol. 27, May 1982, p. 1014-1019. In Russian. refs

The paper examines the prospects of using Schottky-barrier diodes and cyclotron energy converters in ground-based receiving-converting complexes in satellite solar power systems. Rectenna systems based on Schottky-barrier diodes would provide for efficient microwave beam transmission; and load-stable, high-efficiency, high-voltage cyclotron converters would be used to transform microwave energy into direct current. B.J.

A82-34700
AIR COOLING OF GAS TURBINE BLADES
O. N. FAVORSKII and S. Z. KOPELEV (Teploenergetika, vol. 28, Aug. 1981, p. 7-11.) Thermal Engineering, vol. 28, Aug. 1981, p. 435-438. Translation. refs

During the last 20 years, the gas temperature at the inlet of aircraft gas turbines has been raised by 450 K to a temperature of 1650 K. The achievement of the current high operational temperatures, which have led to a considerable enhancement in engine efficiency, has been largely made possible by the development of suitable approaches for cooling the gas turbine blades. The various factors involved in designing an effective cooling procedure are considered, taking into account the necessity that the involved flow processes must not result in a lowering of engine efficiency, and, in connection with large temperature gradients or the introduction of stress-raising design features, must not unduly reduce the operational life of the engine. Attention is given to the internal convective and the convection-film air cooling of blades, the promotion of flow turbulence by means of internal baffles, the hydraulic resistance of internal cooling channels, and merits and drawbacks of perforations. G.R.

A82-34951
SWITCHING NETWORKS FOR REALISATION OF VARIABLE DC TRANSFORMERS COUPLED TO RECTANGULAR ARRAYS
S. SINGER (Tel Aviv University, Tel Aviv, Israel) IEE Proceedings, Part G - Electronic Circuits and Systems, vol. 129, pt. G, no. 3, June 1982, p. 69-75.

The process by which the structure of a rectangular array with variable interconnections is changed can be described by an equivalent circuit in which a nonvariable array is coupled to the load by means of a variable 'DC transformer' (DCT). This kind of array can be applied in cases in which it is necessary to match the source and the load, when either one or both are composed of identical elements which can be organized into a rectangular array structure. Applications of the considered approach are related to maximum power trackers of photovoltaic systems, voltage multipliers, electric cars, and a special type of DC/AC convertor. A description is presented of the realization of a variable array by means of switching networks using a minimum number of switching elements. G.R.

A82-35038* # General Motors Corp., Indianapolis, Ind.
AGT 100 AUTOMOTIVE GAS TURBINE SYSTEM DEVELOPMENT
H. E. G. HELMS (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 11 p. Research sponsored by the U.S. Department of Energy
(Contract DEN3-168)
(AIAA PAPER 82-1165)

General Motors is developing an automotive gas turbine system that can be an alternate powerplant for future automobiles. Work sponsored by DOE and administered by NASA Lewis Research Center is emphasizing small component aerodynamics and high-temperature structural ceramics. Reliability requirements of the AGT 100 turbine system include chemical and structural ceramic component stability in the gas turbine environment. The power train system, its configuration and schedule are presented, and its performance tested. The aerodynamic component development is reviewed with discussions on the compressor, turbine, regenerator, interturbine duct and scroll, and combustor. Ceramic component development is also reviewed, and production cost and required capital investment are taken into consideration. D.L.G.

A82-35039* # Garrett Turbine Engine Co., Phoenix, Ariz.
AGT101 AUTOMOTIVE GAS TURBINE SYSTEM DEVELOPMENT
R. A. RACKLEY and J. R. KIDWELL (Garrett Turbine Engine Co., Phoenix, AZ) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 8 p. Research sponsored by the U.S. Department of Energy
(Contract DEN3-167)
(AIAA PAPER 82-1166)

The AGT101 automotive gas turbine system consisting of a 74.6 kw regenerated single-shaft gas turbine engine, is presented. The development and testing of the system is reviewed, and results for aerothermodynamic components indicate that compressor and turbine performance levels are within one percent of projected levels. Ceramic turbine rotor development is encouraging with successful cold spin testing of simulated rotors to speeds over 12,043 rad/sec. Spin test results demonstrate that ceramic materials having the required strength levels can be fabricated by net shape techniques to the thick hub cross section, which verifies the feasibility of the single-stage radial rotor in single-shaft engines. D.L.G.

A82-35040*# General Motors Corp., Indianapolis, Ind.
CERAMIC APPLICATIONS IN TURBINE ENGINES
J. A. BYRD and H. E. HELMS (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 12 p. Research supported by the U.S. Department of Energy and NASA.
(AIAA PAPER 82-1168)

In the past the potential of vehicular gas engines could not be realized because component materials served to limit the turbine operating temperature, thereby restricting fuel economy and initial cost. It was, therefore, not possible for the vehicular gas turbine to compete with more conventional engines. The emergence of low-cost, high-temperature ceramic components has the potential to reverse this situation. For example, the Allison GT404 engine, operating with ceramic components at turbine inlet temperatures up to 2350 F to 2500 F, has the potential of a fuel economy which is better than that of current Diesel engines. The Allison AGT100 engine operating with ceramic components offers the possibility of a 30% improvement in fuel economy over 1985 spark ignition engines. The materials considered for an employment in the ceramic components include silicon carbide, silicon nitride, aluminum silicate, and lithium aluminum silicate. G.R.

A82-35061*# General Motors Corp., Indianapolis, Ind.
AGT100 TURBOMACHINERY
D. L. TIPTON and T. F. MCKAIN (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 11 p. Research supported by the U.S. Department of Energy
(Contract DEN3-168)
(AIAA PAPER 82-1207)

High-performance turbomachinery components have been designed and tested for the AGT100 automotive engine. The required wide range of operation coupled with the small component size, compact packaging, and low cost of production provide significant aerodynamic challenges. Aerodynamic design and development testing of the centrifugal compressor and two radial turbines are described. The compressor achieved design flow, pressure ratio, and surge margin on the initial build. Variable inlet guide vanes have proven effective in modulating flow capacity and in improving part-speed efficiency. With optimum use of the variable inlet guide vanes, the initial efficiency goals have been demonstrated in the critical idle-to-70% gasifier speed range. The gasifier turbine exceeded initial performance goals and demonstrated good performance over a wide range. The radial power turbine achieved 'developed' efficiency goals on the first build. (Author)

A82-35062*# General Motors Corp., Indianapolis, Ind.
COMBUSTOR DEVELOPMENT FOR AUTOMOTIVE GAS TURBINES
P. T. ROSS, J. R. WILLIAMS (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN), and D. N. ANDERSON (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, and ASME, Joint Propulsion Conference, 18th, Cleveland, OH, June 21-23, 1982, AIAA 9 p. Research supported by the U.S. Department of Energy refs
(Contract DEN3-168)
(AIAA PAPER 82-1208)

The development of a combustion system for the AGT 100 automotive gas turbine engine is described. A maximum turbine inlet temperature of 1288 C is reached during the regenerative cycle, and air up to 1024 C is supplied to the combustor inlet. A premix/prevaporization ceramic combustor employing variable geometry to control burning zone temperature was developed and tested. Tests on both metal and ceramic combustors showed that emissions were a function of burner inlet temperature (BIT). At 999 C BIT, NO(x) emissions were two orders of magnitude below program goals, and at the same temperature but at a different variable geometry position, the CO was 30 times below program goal. Tests to evaluate the durability of the ceramic materials showed no failures during steady-state operation; however, some cracks developed in the dome during extended transient operation. C.D.

A82-35229
INDUCTIVE POWER TRANSFER FOR PROPULSION
C. E. WALTER (California, University, Livermore, CA) Journal of Advanced Transportation, vol. 16, Spring 1982, p. 73-86. refs
(Contract W-7405-ENG-48)

Current research and development work on inductive power transfer to moving road vehicles at the Lawrence Livermore National Laboratory is described. The Roadway Powered Electric Vehicle (RPEV) project involves the use of an air gap transformer which inductively couples the primary power source in the roadway to the secondary, which is suspended beneath the vehicle. Incorporating electrical battery storage for operation independent of the primary power source, this scheme could provide highway transportation with no visual or audible presence, no noxious fumes, and without dedicated use constraints such as those of railways. Attention is given to the design details of roadway power components and automobile power system configuration, and the impact on electrical utility generating capacity is assessed. An appeal is made for a continuation of substantial state and federal funding of RPEV research, on the grounds of the severity of national dependence on imported petroleum. O.C.

A82-35321*# Garrett Turbine Engine Co., Phoenix, Ariz.
THE AGT 101 ADVANCED AUTOMOTIVE GAS TURBINE
R. A. RACKLEY and J. R. KIDWELL (Garrett Turbine Engine Co., Phoenix, AZ) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 9 p. Research supported by the U.S. Department of Energy
(Contract DEN3-167)
(ASME PAPER 82-GT-72) MEMBERS, $2.00; NONMEMBERS, $4.00

A development program is described whose goal is the accumulation of the technology base needed by the U.S. automotive industry for the production of automotive gas turbine powertrains. Such gas turbine designs must exhibit reduced fuel consumption, a multi-fuel capability, and low exhaust emissions. The AGT101 powertrain described is a 74.6 kW, regenerated single-shaft gas turbine, operating at a maximum inlet temperature of 1644 K and coupled to a split differential gearbox and automatic overdrive transmission. The engine's single stage centrifugal compressor and single stage radial inflow turbine are mounted on a common shaft, and will operate at a maximum rotor speed of 100,000 rpm. All high temperature components, including the turbine rotor, are ceramic. O.C.

A82-35349#
THE AGT 100 AUTOMOTIVE GAS TURBINE STATUS AND ASSESSMENT
H. E. BARRETT (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 11 p.
(ASME PAPER 82-GT-118) MEMBERS, $2.00; NONMEMBERS, $4.00

The progress of the key elements of the AGT 100, an advanced gas turbine power train system being developed at General Motors under NASA contract, is discussed. The project goals, including the design objectives, are stated, and the two-phase schedule is described. The AGT 100 basic engine data and the weight of its ceramic and strategic materials are shown. The engine performance at maximum and part power and at idle are indicated for centrifugal compressor, radial gas turbine, radial power turbine, and regenerator. Each of these parts is discussed in detail, as are the interturbine duct and scroll and the combustor. The ceramic component development is discussed with special attention given to the combustors and turbine rotor. Finally, cost factors are examined and future prospects are assessed. C.D.

A82-35422#
THE CONTROL OF ENGINE VIBRATION USING SQUEEZE-FILM DAMPERS
R. HOLMES (Sussex, University, Brighton, England) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 8 p. Research supported by the Science Research Council and Ministry of Defence. refs
(ASME PAPER 82-GT-241) MEMBERS, $2.00; NONMEMBERS, $4.00

This paper describes the following roles of a squeeze-film damper when used in gas turbine applications as a means of reducing vibration and transmitted force due to unbalance: (1) as an element in parallel with a soft spring in a vibration isolator, and (2) as an element in series with the stiffness of the engine pedestal. The effects of cavitation on performance are elucidated and the dangers of jump phenomena and subsynchronous response are discussed. Experimental work is described in which both roles of the squeeze-film damper are investigated and the results are compared with theoretical predictions. (Author)

A82-35432#
CERAMIC COMPONENTS FOR AUTOMOTIVE AND HEAVY DUTY TURBINE ENGINES - CATE AND AGT 100
H. E. HELMS and J. A. BYRD (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 10 p. refs
(ASME PAPER 82-GT-253) MEMBERS, $2.00; NONMEMBERS, $4.00

Detroit Diesel Allison is actively applying advanced ceramic materials to components in gas turbine engines. Silicon carbide, silicon nitride, aluminum silicate, lithium aluminum silicate, and mullite are materials being used in various components in both the DDA GT 404-4 and AGT 100 engines. Approximately 9400 hr of ceramic component operating time in the GT 404 engine has been accumulated, and design, component processing, proof testing, and engine testing experience have begun to show the applicability of ceramic materials in production engines. Material variability, processing procedures, strength characterization, and nondestructive evaluations are emerging as critical but controllable factors. Ceramic components offer the potential of significant fuel consumption improvements in gas turbine engines for vehicles and other applications. (Author)

A82-35440#
PHYSICAL VAPOR DEPOSITION OF CERAMIC COATINGS FOR GAS TURBINE ENGINE COMPONENTS
R. E. DEMARAY (Airco Temescal, Metallurgical Products Div., Berkeley, CA), J. W. FAIRBANKS (U.S. Department of Energy, Combustion Heat Systems Div., Washington, DC), and D. H. BOONE (California, University, Berkeley, CA) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 8 p. refs
(ASME PAPER 82-GT-264) MEMBERS, $2.00; NONMEMBERS, $4.00

Significant improvements are reported in turbine engine ceramic thermal barrier coatings, with respect to both hot corrosion resistance and ceramic thermal cycle fatigue. Such coatings in turbine engine hot section airfoils improve engine performance, durability and fuel economy. After an historical account of ceramic coating development, attention is given to the recent development of mechanically segmented, or microcolumnar structure, coatings produced by the physical vapor deposition (PVD) of ceramic materials on metallic turbine airfoil components. PVD coatings accommodate thermal cycle stresses due to thermal expansion coefficient differences between the coating and its metallic substrate. Hot corrosion, erosion, and thermal fatigue protection properties are considered, and it is concluded that hot corrosion protection is provided for a wide range of fuels which includes the emerging alternate, coal-derived formulations. O.C.

A82-35450*# General Electric Co., Cincinnati, Ohio.
PROGRESS IN THE DEVELOPMENT OF ENERGY EFFICIENT ENGINE COMPONENTS
R. W. BUCY (General Electric Co., Cincinnati, OH) American Society of Mechanical Engineers, International Gas Turbine Conference and Exhibit, 27th, London, England, Apr. 18-22, 1982, 7 p. refs
(Contract NAS3-20643)
(ASME PAPER 82-GT-275) MEMBERS, $2.00; NONMEMBERS, $4.00

Component test results are presented for the NASA Energy Efficient Engine program, whose design goals relative to the CF6-50C reference engine include a 12% reduction in specific fuel consumption, 5% reduction in direct operating costs, and 50% reduction in specific fuel consumption deterioration rate over the course of commercial service. Emphasis is placed on the engine's high pressure compressor, which has a design pressure ratio of 23:1, and has completed a series of component tests whose resulting configuration is expected to meet all major objectives of the program. Descriptions are given of the core engine and integrated core/low spool tests, and system test benefits are discussed. Attention is given to the design features of the engine's double annular combustor, high and low pressure air turbines, and scale model exhaust mixer. O.C.

A82-35481#
THE FEASIBILITY OF ELECTRIC POWER GENERATION BY THE WIND ON THE UNIVERSITY OF NEW ORLEANS CAMPUS
L. B. HILBERT, JR. (Exxon Corp., Houston, TX) and W. S. JANNA (New Orleans, University, New Orleans, LA) American Society of Mechanical Engineers, Energy-Sources Technology Conference and Exhibition, New Orleans, LA, Mar. 7-10, 1982, 8 p. refs
(ASME PAPER 82-PET-1) MEMBERS, $2.00; NONMEMBERS, $4.00

A82-35482#
THE SOUTHERN CALIFORNIA EDISON WIND TURBINE GENERATOR TEST PROGRAM
M. C. WEHREY and R. J. YINGER (Southern California Edison Co., Rosemead, CA) American Society of Mechanical Engineers, Energy-Sources Technology Conference and Exhibition, New Orleans, LA, Mar. 7-10, 1982, 6 p.
(ASME PAPER 82-PET-2) MEMBERS, $2.00; NONMEMBERS, $4.00

This paper deals with the second area of Edison's wind energy R&D program: the demonstration of various WTG designs to provide, over a period of two to three years, the data needed to support the planning, installation and operation of WTGs on a commercial scale. The overall scope of the program is to document the performance of the WTGs being tested, to assess the operation and maintenance requirements of future WTGs, to train Edison personnel as WTG operators, and to evaluate the impact of WTGs on the Edison electrical system. The company is currently assessing horizontal-axis and vertical-axis WTGs. The results from the test program will provide information about specific performance characteristics and, at the same time, give Edison general operating experience with wind turbines. From the program Edison will be better able to properly judge the role that wind turbines can play in meeting future electrical generation needs. (Author)

A82-35483#
SMALL WIND ENERGY CONVERSION SYSTEMS, APPLICATION AND PERFORMANCE
J. H. NORTON, JR. (North Wind Power Co., Inc., Moretown, VT) American Society of Mechanical Engineers, Energy-Sources Technology Conference and Exhibition, New Orleans, LA, Mar. 7-10, 1982, 6 p.
(ASME PAPER 82-PET-3) MEMBERS, $2.00; NONMEMBERS, $4.00

This paper examines the two basic applications of SWECS - remote and utility interface - in the context of the products of the North Wind Power Company. First, the discussion of remote power briefly reviews the history of this type of application, describes

the specifications of the HR2 high reliability 2kW wind system, and examines in detail two commercial applications in the petroleum industry - their operation, environment and performance. Second, the discussion of utility interface briefly reviews the history of the LI6 line interface 6kW wind system, and discusses its potential application in small commercial windfarms, remote community power systems and dispersed industrial, residential and agricultural applications. Finally, a perspective on the future of small wind energy technology is given. (Author)

A82-35484#
WISCONSIN POWER AND LIGHT COMPANY'S WIND ENERGY RESEARCH AND DEMONSTRATION PROGRAM
C. C. DEWINKEL (Wisconsin Power and Light Co., Madison, WI) American Society of Mechanical Engineers, Energy-Sources Technology Conference and Exhibition, New Orleans, LA, Mar. 7-10, 1982, 3 p.
(ASME PAPER 82-PET-4) MEMBERS, $2.00; NONMEMBERS, $4.00

A82-35486#
DESIGN, PERFORMANCE AND ECONOMICS OF THE DAF INDAL 50 KW AND 375 KW VERTICAL AXIS WIND TURBINE
L. A. SCHIENBEIN and D. J. MALCOLM (DAF Indal, Ltd., Mississauga, Ontario, Canada) American Society of Mechanical Engineers, Energy-Sources Technology Conference and Exhibition, New Orleans, LA, Mar. 7-10, 1982, 10 p. Department of Supply and Services refs
(Contract DSS-17SR-3115-0-4605)
(ASME PAPER 82-PET-6) MEMBERS, $2.00; NONMEMBERS, $4.00

A review of the development and performance of the DAF Indal 50 kW vertical axis Darrieus wind turbines shows that a high level of technical development and reliability has been achieved. Features of the drive train, braking and control systems are discussed and performance details are presented. A description is given of a wind-diesel hybrid presently being tested. Details are also presented of a 375 kW VAWT planned for production in late 1982. A discussion of the economics of both the 50 kW and 375 kW VAWTs is included, showing the effects of charge rate, installed cost, operating cost, performance and efficiency. The energy outputs are translated into diesel fuel cost savings for remote communities. (Author)

A82-35487#
PROCEDURES FOR MODELING WIND TURBINE PERFORMANCE FROM SITE WIND DATA
W. T. PENNELL and A. H. MILLER (Battelle Pacific Northwest Laboratories, Richland, WA) American Society of Mechanical Engineers, Energy-Sources Technology Conference and Exhibition, New Orleans, LA, Mar. 7-10, 1982, 10 p. Research sponsored by the Electric Power Research Institute refs
(Contract DE-AC06-76RL-01830)
(ASME PAPER 82-PET-7) MEMBERS, $2.00; NONMEMBERS, $4.00

A key problem in wind turbine siting is estimating how a given wind turbine will perform at a given site. Solving this problem requires a model for converting wind information from a site into accurate simulations of how a wind turbine installed at that site would have performed. This paper reviews current procedures for modeling wind turbine energy production and discusses the strengths and weaknesses of each procedure. Wind turbine performance simulations are compared at typical wind turbine sites. Comparisons of these simulations, as well as comparisons with existing data from actual wind turbine installations, suggest that accurate estimates of energy production for large wind turbine generators require simulation of the wind turbine's start-up, shutdown and, for the case of horizontal axis machines, yawing behavior. (Author)

A82-35489#
THE DEVELOPMENT OF A 10 METER WIND TURBINE GENERATOR
H. MEYER (Windworks, Inc., Mukwonago, WI) American Society of Mechanical Engineers, Energy-Sources Technology Conference and Exhibition, New Orleans, LA, Mar. 7-10, 1982, 5 p. Research supported by the U.S. Department of Energy.
(ASME PAPER 82-PET-10) MEMBERS, $2.00; NONMEMBERS, $4.00

An 8 kW, 10 m-diameter horizontal axis wind system whose prototype has been recently tested is described. The wind turbine is suitable for use in dispersed, interconnected applications. After prototype development, the design was refined and re-engineered for volume production. Power is generated by means of a direct-drive, permanent magnet alternator which operates over a variable speed range. This feature allows fixed turbine blade pitch operation up to rated wind speed, while maintaining optimum aerodynamic characteristics. Attention is given to the helicopter-like flapping rotor design, generator configuration, and tower erection method. O.C.

A82-36076
INTERNATIONAL SYMPOSIUM ON WIND ENERGY SYSTEMS, 3RD, DANMARKS TEKNISKE HOJSKOLE, LYNGBY, DENMARK, AUGUST 26-29, 1980, PROCEEDINGS
H. S. STEPHENS, (ED.) and C. A. STAPLETON (British Hydromechanics Research Association, Cranfield, Beds., England) Symposium sponsored by the British Hydromechanics Research Association. Cranfield, Beds., England, BHRA Fluid Engineering, 1980. 633 p $66.25

The design, fabrication, materials, and numerical modeling of large and small wind turbines, wind energy programs in various countries, and methods of measuring the available wind resource are discussed. Attention is given to the DOE/NASA, SERI, and U.K. wind turbine development and testing programs, as well as to blade construction for large WECS. Siting considerations are examined in terms of surveys performed in Hawaii, California, and New Hampshire. The choice of generator type is investigated, as are structural design criteria for large WECS, drive train assemblies, measurements of WECS output, and the performance of Danish, German, and Swedish experimental machines. The aerodynamic modeling of vertical axis wind turbines, the performance of wind turbine arrays, and remote applications of wind turbine technology are detailed. Finally, methods of integrating wind-derived electricity with the grid are explored. M.S.K.

A82-36077
ASSESSMENT OF OFFSHORE SITING OF WIND TURBINE GENERATORS
D. LINDLEY, P. B. SIMPSON (Taywood Engineering, Ltd., Southall, Middx., England), U. HASSAN (ERA Technology, Ltd., Leatherhead, Surrey, England), and D. MILBORROW (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 17-42. refs

A technical and economic assessment has been made of the generation of electricity using wind turbine generators located in shallow waters off the coast of the United Kingdom. This assessment entailed studies of siting criteria, meteorology, sea surface conditions, engineering geology, construction materials, support structures, marinisation of complete WTG installations, effect of cluster configuration on performance, electrical transmission and control, availability and environmental issues. On the basis of these studies, an analysis has been made to determine economic and performance trends of clusters of up to 200 machines of a maximum of 10 MW individual generating capacity. Generating costs based on central values in the ranges of the design parameters are found to exceed predicted economic value in the year 2000 by a factor of about 3, whilst with large diameter

turbines and average wind speeds exceeding the central value this factor is reduced to about 2. (Author)

A82-36078
WIND POWER GENERATION FOR NATIONAL AND REGIONAL GRID SYSTEMS DESIGN PROPOSALS FOR GENERATION AND TRANSMISSION
R. FREER In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 43-60. refs

Design features of large and medium WECS, the utility interconnection, and siting for introduction of wind-derived electricity as an integral part of the U.K. national electric grid are described. Noting that the technology to fabricate the machines exceeds the experience with applications, the construction of small test complexes of wind turbines is recommended in representative rural, coastal, and offshore sites to gain operational data and increase the ability to relate local winds to wind systems output. A hydraulic power system involving oil pumped by the rotor shaft to drive a generator at the base of the tower is planned for the U.K. WECS, producing 2 MWe at 40 rpm in a 15 m/sec wind, and 4.2 MW in a 21 m/sec wind. Control methods of arrays are examined, along with the 10-15 MW/sq km sized land-based farms. Offshore facilities are foreseen to require transmission of power to a central facility before transmission to shore to reduce costs. M.S.K.

A82-36079
A REVIEW OF THE SERI WIND ENERGY INNOVATIVE SYSTEMS PROGRAM
I. E. VAS and P. SOUTH (Solar Energy Research Institute, Golden, CO) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 61-74. Research supported by the U.S. Department of Energy.

Features of innovative wind energy conversion systems evaluated and/or tested at the Solar Energy Research Institute are reviewed. Cost, performance, and engineering data were acquired for the machines, along with proof-of-concept demonstrations. Machines which were examined included a straight-bladed vertical axis wind turbine with circulation controlled airfoils, the Grumman tornado wind energy tower with louvers, a wind-powered charged aerosol generator which has no moving parts and gains energy directly from the wind, and the electrofluid dynamic wind driven generator for providing low-mobility charged water droplets for deriving energy from the wind. Extracting mechanical energy from vortex flows which yield the latent heat of water vapor in humid air was tested, as were the Madaras cylinders mounted on rail cars on tracks, a vortex augmentor WECS, and an oscillating vane wind energy converter. M.S.K.

A82-36080
SITES FOR WIND-POWER INSTALLATIONS - PHYSICAL MODELLING OF THE WIND FIELD OVER KAHUKU POINT, OAHU, HAWAII
H. C. CHIEN, R. N. MERONEY, and V. A. SANDBORN (Colorado State University, Fort Collins, CO) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 75-90. Research supported by the U.S. Department of Energy. refs

A82-36082
STANDARD DEVIATIONS AND CONFIDENCE INTERVALS FOR ATMOSPHERIC DESIGN CRITERIA USED IN WECS DEVELOPMENT
W. FROST (Tennessee, University, Tullahoma, TN) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 107-131. refs

An engineering handbook entitled Engineering Handbook on the Atmospheric Environmental Guidelines for Use in Wind Turbine Generator Development was prepared under a NASA contract to provide design criteria recommended for use in both small- and large-scale WECS. This paper supplements the design criteria by carrying out a detailed comparison of the recommended design curves with experimental data for (1) vertical shear horizontal wind and (2) atmospheric wind speed turbulence spectra and intensities. These data are directly used in analysis of the vibration and fatigue loading of wind turbine rotor blades. (Author)

A82-36083
DEVELOPMENT OF COMPOSITE BLADES FOR LARGE WIND TURBINES
H. W. GEWEHR (Kaman Aerospace Corp., Bloomfield, CT) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 133-140.

The design, analysis, and tests of a 150 ft length fiberglass wind turbine blade and the development of a similar set of blades for the NASA Mod-1 WECS are described. Transverse filament tape was employed in order to lower costs on the composite blades. The woven roving E-glass tape featured fibers uniformly oriented across the tape width. Components of the blade included a wound glass/epoxy spar, an E-glass/polyester trailing edge spline made from pultrusions, sandwich panels made of resin impregnated kraft paper honeycomb faced with E-glass cloth epoxy skins, and a steel hub adaptor. The blade weighed 16,300 kg. Ultimate strength properties are given, as well as costs at $22/kg. The blades for the Mod-1 are intended to last through 400 million fatigue cycles over 30 years of operation. Details of lightning tests which proved the blade suffered minimal damage in a strike are presented. M.S.K.

A82-36084
EVOLUTION OF THE FLEXIBLE BLADE CONCEPT /VERTICAL AXIS WINDMILLS/
J. M. DE LAGARDE (Aerowatt Co.; Montpellier, Ecole Nationale Superieure Agronomique, Montpellier, France) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 159-168.

Operational characteristics of a panemone windmill with elastically fastened rotors are examined qualitatively and modeled numerically. The blades freely rotate at the leading edge while the trailing edge is spring-attached to the axle of the machine. The spring allows the blade to maintain a relatively constant angle of attack into the wind, thus raising the coefficient of lift in more regions of the rotation, permits self-starting, and provides efficiencies approaching that of Darrieus wind turbines. An inviscid model for panemones is developed and drag forces are considered for rigidly connected blades and for the elastically fastened rotors. The latter are found to maintain a constant circumferential speed once a maximum is reached, and then begin aerodynamic braking at another, higher limit. Optimum solidity choices are discussed. M.S.K.

A82-36085
COMBINED EFFECTS OF DETERMINISTIC AND RANDOM LOADS IN WIND TURBINE DESIGN
A. RAAB (Sikob AB, Sweden) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 169-182. Research sponsored by the Namnden for Energiproduktionsforskning. refs

Deficiencies of modeling the deterministic loading on wind turbine blades as a cumulative sum of wind shear, mean wind, tower shadow, gravitational, and centrifugal forces are examined. It is analytically shown by application of the Palmgren-Miner rule that periodic loadings which coincide in cycle result in damage exceeding the sum of the individual stresses. The necessity of calculating the probability that coincidence of cycles will occur is stressed for making fatigue life predictions for wind turbines, and it is suggested that a weighted sum is useful for simulation or for a probabilistic interaction method. The simulation is developed in terms of sample functions for individual wind speeds. Turbulence is defined by either one- or two point spectra and applied to a

sample point on the blade. Further attention is given to fatigue evaluation as combinations of partial damages M.S.K.

A82-36086
LOAD CASES FOR WIND ENERGY CONVERSION SYSTEMS
G. TORNKVIST (Saab-Scania AB, Linkoping, Sweden) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 183-192. Research supported by the Namnden for Energiproduktionsforskning. refs

Loading forces which impinge on the design of WECS are explored, based on the results of tests in the U.S. and western European countries. Wind characteristics known to influence WECS fatigue life include wind speed duration, extreme wind speed, wind shear, and turbulence. Wind speed duration is obtainable by Weibull distributions which characterize the deviation from a given wind speed in a year, and the probability that a certain speed will occur. Extreme wind speeds are found from historical data locally acquired, while turbulence is modeled in terms of resonant and nonresonant components. Wind shear is defined in gradients up to 10 m/sec. The Palmgren-Miner rule is noted to have been applied to fatigue life predictions for the NASA Mod-1 wind turbine. Finally, malfunctions during normal operating sequences including start-up, power generation, and parking are discussed. M.S.K.

A82-36087
APPLICATION OF THE FINITE ELEMENT METHOD TO THE STUDY OF THE BEHAVIOUR OF BLADES OF INDUSTRIAL WIND ENERGY SYSTEMS
J. SOREL, D. BAINVILLE, M. MAEGEY (Commissariat a l'Energie Atomique, Paris, France), J. M. NOEL, and G. SEGER (Aerowatt Co., Paris, France) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 193-206.

Finite element analyses of the stresses in the blade root of a commercially available 9.2 m diameter rotor wind turbine were performed and compared to tests results. The blades were an extruded aluminum alloy, internally ribbed with a constant cross sectional profile. Stresses are due to bolt tightening and operating conditions, including inertial loads of weight and centrifugal force. Wind loading occurs in the rotational plane and the plane perpendicular to it, generating a bending moment on the blade. The bending moment then becomes the cumulative effect of aerodynamical and gyroscopic loads. The effects of hollow blade and solid blade construction were examined to find anomalies in the stress distributions. Maximum stresses were found to be located just outside of the footing, and tests with a clamped sample blade which experienced the calculated loads revealed no permanent deformation and agreement with predicted stress. M.S.K.

A82-36088
ON WIND TURBINE POWER MEASUREMENTS
S. FRANDSEN and C. J. CHRISTENSEN (Forsogsanlaeg Riso, Roskilde, Denmark) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 207-222. refs

A statistical treatment of the wind turbine power curve is presented. It is shown that variations in u and p can be handled more conventionally by means of two parameters: The coherent variation along the power curve and the incoherent across the curve. The averaging time problem is discussed. The response of the power train to turbulence in the wind and to grid frequency variations is discussed in a spectral language. A spectral response function for the power train is derived. (Author)

A82-36089
DESCRIPTION OF THE TWO DANISH 630 KW WIND TURBINES, NIBE-A AND NIBE-B, AND SOME PRELIMINARY TEST RESULTS
B. M. PEDERSEN (Danmarks Tekniske Hojskole, Lyngby, Denmark) and P. NIELSEN (DEFU, Denmark) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 223-238.

A82-36090
THE CONCEPTUAL DESIGN OF THE HIGH SPEED RATIO WIND ROTOR FOR THE 52 M DIAMETER HORIZONTAL AXIS VOITH WIND ENERGY CONVERTER
W. WEBER (Voith Getriebe, Heidenheim, West Germany) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 239-251. refs

A82-36091
DRIVE TRAIN ASSEMBLY OF THE SWEDISH WTS 3
N. G. BYGGETH, K.-E. HALLSTEN, and L. THORESON (Karlskronavarvet AB, Sweden) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 253-267.

Design features and expected operational characteristics of the Swedish WTS 3 3 MW WECS are reviewed. The wind turbine has a hub height of 80 m, a rotor diameter of 80 m, 2 blades, operates downwind, has a teetered hub, free yaw, and a 1:60 gear ratio. The blades are made of epoxy plastic and fiber glass, pitch controlled by hydraulic activation, and coupled by way of a soft shaft to the drive train. Nominal rotation is at 25 rpm, stepped up to 1500 rpm at the generator. The low speed shaft is provided with a disk brake for stopping and parking the rotor. Specific design considerations for oil drainage, the hub interface, the gear box interface, the low pressure oil return holes from the blade pitch change machinery, and the low pressure oil transfer bearing are discussed. The WTS 3 is intended for 30 yr of operation, with first rotation to have occurred in the summer of 1981. M.S.K.

A82-36092
ALTERNATOR DESIGNS FOR DIRECT COUPLING TO REMOTE WIND ENERGY SYSTEMS
R. W. MENZIES, R. M. MATHUR (Manitoba, University, Winnipeg, Canada), and W. R. BULLOCK (Bristol Aerospace, Ltd., Winnipeg, Canada) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 269-278. refs

System specifications and design considerations for the fabrication of Darrieus wind turbine generators producing up to 20 kW and operating in arctic conditions are reviewed. The conclusions are based on operation of an actual installation on an ice island in the Arctic Ocean. The 7.6 m diameter VAWT started turning in a 14 kph wind and powered the equipment at a GOES satellite relay station. To perform in hostile conditions, the generator was required to feature a low operating speed, have no drag torque at low speeds up to the start-up, yield either dc or 3-phase ac power, and be self-exciting. Major studies concentrated on inductor alternators, and numerical modeling procedures for generator efficiencies, materials, labor costs, and optimization of the airgap length are provided. A permanent magnet alternator was favored for constant voltage application up to 2 kW, while the Guy-type inductor alternator with 3-phase operation was considered best for reliable, higher power performance. M.S.K.

A82-36093
DYNAMIC CHARACTERISTICS OF A WIND DRIVEN INDUCTION GENERATOR EQUIPPED WITH THYRISTOR CONTROLLED INDUCTANCES ON THE STATOR SIDE
A.-A. EDRIS (Chalmers Tekniska Hogskola, Goteborg, Sweden) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluids Engineering, 1980, p. 279-296. Research sponsored by the Namnden for Energiproduktionsforskning. refs

A82-36094
SOME ASPECTS OF SMALL AEROGENERATOR DESIGN AND TESTING
I. K. BUEHRING (Exeter, University, Exeter, Devon, England) and L. L. FRERIS (Imperial College of Science and Technology, London, England) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 297-305. Research supported by the Science Research Council.

The generating and power conditioning system, the testing procedures, and the results of an analog computer simulation of small wind energy conversion system (SWECS) aerodynamics for low-cost SWECS which produce electricity for home and space heating and for grid-interface are described. Various permanent magnet alternators are considered in terms of weight, cost, and power conditioning requirements. A gear box is found to be necessary to meet demands of economy, compactness, and coupling rotor to alternator. Tests with a cambered plate, a sailwing, and a single blade rotor are described in terms of performance in different wind regimes. Control strategies which were explored included uncontrolled operation with a resistive load, load switching, power feedback control, and tip speed ratio control. Best results were obtained with the tip-speed ratio control, which was concluded to be due to its characteristic of transient optimization. M.S.K.

A82-36095
STRUCTURAL DESIGN AND MAINTENANCE POLICIES FOR LARGE WIND TURBINES
D. W. BRIDSON (Exeter, University, Exeter, Devon, England) and P. J. WORTHINGTON (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 307-321. refs

Aerospace structural design and maintenance policies are reviewed to find policies and procedures suitable for applications to large WECS. Failures occurring from fatigue, corrosion, fretting, erosion, and water ingestion in composites are noted to be predictable to a limited degree, while failure due to overspeed overloading, ice accretion, and accidents are random. Acceptable risk levels are computed and components which cannot be allowed to fail are identified. Fatigue testing procedures which can accurately reflect the expected fatigue life of structural components are outlined, and test results are employed to develop reliable inspection schedules. The introduction of fail-safe design through multiple load paths ensures that no catastrophic failure can occur before inspection due to a transfer of load-bearing burden to structural parts which have not failed. Routine and opportunity visual and nondestructive WECS inspection are described.
M.S.K.

A82-36097
'L-180 POSEIDON' - A NEW SYSTEM CONCEPT IN VERTICAL AXIS WIND TURBINE TECHNOLOGY
O. LJUNGSTROM (Flygtekniska Forsoksanstalten, Bromma, Sweden) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 333-355. Research supported by the Styrelsen for Teknisk Utveckling and Namnden for Energiproduktionsforskning. refs

Operating and design characteristics, along with costs of the 20 MW Poseidon L-180 vertical axis wind turbine (VAWT) for offshore siting are described. The total height is projected to be 210 m, with a turbine diameter of 180 m. Double airfoil blades are attached at one point at the top of the tower and to a base ring with a 60 m diameter at the center of the tower. The two sets of dual blades mounted 90 deg apart would propel the base ring in a track around the tower at 6.4 rpm on rollers, of which every fourth would be a generator. The L-shape of the blade arrangements has been demonstrated to reduce rotor loading oscillations in wind tunnel tests, and additional calculations have shown that reduced loads in parking situations in high winds permit the construction of the 20 MW-sized machine. The design of the machine is noted to be unsuitable in smaller sizes, and construction of the 2.25 m chord blades is detailed. The L-180 is projected to produce 44.5 GWh/yr at 9.5 m/sec mean speeds. M.S.K.

A82-36098
A VORTEX-WAKE ANALYSIS OF A HORIZONTAL-AXIS WIND TURBINE AND A COMPARISON WITH A MODIFIED BLADE-ELEMENT THEORY
M. B. ANDERSON (Cambridge University, Cambridge, England) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 357-374. Research supported by the Science Research Council. refs

A theoretical method is developed for determining the geometry and strength distribution of the vortex-wake generated by a horizontal-axis wind turbine. The angle of relative flow and induced velocities are compared with those from a modified blade-element theory. The blade-element theory includes tip losses which are evaluated from either the Goldstein or Prandtl solution of the potential flow about a helical vortex sheet. (Author)

A82-36099
THE 25 M EXPERIMENTAL HORIZONTAL AXIS WIND TURBINE /25 M HAT/
F. J. C. SCHELLENS (FDO Technische Adviseurs, Amsterdam, Netherlands) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 375-390.

Design consideration and physical dimensions of a 25-m diameter experimental horizontal axis wind turbine (HAWT) in the Netherlands are presented. The turbine is intended for operation in the 5-6 to 17 m/sec regime, yielding an operating time of 4711 hr/yr at a site with a 3258 kWh/sq m/yr wind regime. The HAWT is equipped with a pitch change mechanism for coupling to a dc generator and dc/ac converter. A tip-speed ratio of 8 was chosen, yielding a rotor speed of 8.37 rad/sec, a power coefficient of 0.46, shaft power of 302 k/W, and a blade twist of 14.7 deg. An average power of 57 kWe is expected. Limiting load conditions which impinge on fatigue and elastic deformation behavior are described, noting the large damping modes present due to the use of a concrete tower. The HAWT is an upwind configuration, with a 1/20 gear ratio, a line-commutated converter, and active yaw control M.S.K.

A82-36100
TESTS PERFORMED ON THE 2 MW TVIND WECS
S. A. JENSEN and E. T. D. BJERREGAARD (Danish Ship Research Laboratory, Denmark) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 391-400.

Results from a 16-channel monitoring program on the Tvind 2 MW wind turbine are presented. The WECS has a rotor diameter of 54 m, three blades, operates downwind, has a cone angle of 9 deg, a tilt angle of 4 deg and each blade is constructed of glass-fiber reinforced epoxy. The blades were monitored for strain angular velocity, and position, the shaft for torque, and additional data were gathered on the linear acceleration of the nacelle, the wind speed at hub height, and the wind direction relative to the rotor. A difference in the center of mass of one of the three blades was detected during the torque measurements. The blade was also observed to experience tensile and compressive stresses,

with variations due to gravitational forces. Measurements of the tower wake effect on the torque and blade strains were not possible. M.S.K.

A82-36101
THE EFFICIENCY OF WIND TURBINE CLUSTERS
E. A. BOSSANYI, G. E. WHITTLE, P. D. DUNN, N. H. LIPMAN, P. J. MUSGROVE (Reading, University, Reading, Berks., England), and C. MACLEAN (Reading, University, Reading, Berks.; Science and Engineering Research Council, Rutherford Appleton Laboratory, Didcot, Oxon, England) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 401-416. refs

A computer simulation for the prediction of wind depletion in an array of wind turbines is presented, along with a discussion of the deficiencies and possible improvements in current array prediction techniques. Formulations for determining the available wind velocity profile without, with one, and with the addition of a cluster of wind turbines are explored analytically. Various values for the friction velocity, surface roughness length, and boundary layer thickness are derived. A computer simulation is detailed, taking as input a WECS' operating characteristics and wind speed and as output yields the power and the drag coefficient. It is found that clustering decreases the optimum rated wind speed, that the magnitude of decrease is dependent on the type of machine considered, and that difficulties exist in transferring wind tunnel data to actual wind turbine arrays. M.S.K.

A82-36102
MODELLING OF WIND TURBINE ARRAYS
P. J. H. BUILTJES (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, The Hague, Netherlands) and D. J. MILBORROW (Central Electricity Generating Board, Central Electricity Research Laboratories, Leatherhead, Surrey, England) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 417-430. refs

Results derived from two sets of wind turbine wind tunnel tests are compared, with emphasis on the accuracy of modeling techniques and the effects of scale. Despite differences in approach, agreement is found between the sets of results, and comparisons with theoretical studies indicate that wind turbine array outputs can be predicted with reasonable accuracy. Although loss of power due to interactive effects is dependent on such factors as the size of the array and the spacing between its units, it is found that losses can be kept to within 20%. It is concluded that cluster configurations with spacings of 5 to 12 rotor diameters will yield power densities on the order of 2-10 mW per kilometer of surface. O.C.

A82-36104
ON WAKE DECAY AND ROW SPACING FOR WECS FARMS
P. A. TAYLOR (Department of the Environment, Atmospheric Environment Service, Ottawa, Canada) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 451-468. refs

A numerical model of wakes in the neutrally stratified atmospheric boundary layer is developed and applied to the flow behind horizontal and vertical axis wind turbines. The model is linearized, uses boundary layer approximations and is integrated across turbine rows but should still provide useful estimates of power reductions at turbines in second and subsequent rows of a WECS farm array. Variations with turbine size and other characteristics are investigated as well as variations due to different surface roughness, wind speed and direction. Comparisons are made with other theories of wake interactions and with wind tunnel investigations. (Author)

A82-36106
THE STATUS OF WINDPOWER RESEARCH AND DEVELOPMENT FOR SPACE AND WATER HEATING IN THE UNITED STATES
D. E. CROMACK, J. G. MCGOWAN, and W. E. HERONEMUS (Massachusetts, University, Amherst, MA) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 485-498. Research supported by the U.S. Department of Energy. refs

A82-36107
SUBSTITUTION OF DIESEL POWER PLANTS BY SOLAR AND WIND ELECTRICITY GENERATORS - A CASE STUDY FOR A TROPICAL ISLAND
R. MINDER (Electrowatt Engineering Services, Ltd., Zurich, Switzerland) and D. GILBY (Electrowatt Engineering Services, Ltd., England) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 521-531.

A82-36108
A REGIONAL WIND-HYDRO ELECTRICITY SUPPLY SYSTEM
B. SORENSEN (Copenhagen, University, Copenhagen, Denmark) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 533-543. refs

A simulation for a wind-hydro storage system involving a large wind turbine capacity in Denmark reciprocating with the 100% hydro system in Norway is described. A transfer capability either way of 5 GW was assumed for a system in which Denmark would receive hydro-generated electricity when insufficient winds were available in Denmark and Norway would buy wind-derived power to replace hydro power, thus effectively storing fuel, when winds were strong in Denmark. The model included diurnal and seasonal load and wind availability fluctuations, in addition to the historical power capacity of Norwegian hydro. The Danish/Norwegian power ratio was set at 0.3, and Danish wind-produced electricity was found to penetrate the Norwegian system by 3%. Losses from transmission were calculated to be 8% of the wind production. The combined wind/hydro system is noted to eliminate the necessity for thermal power station back-up. M.S.K.

A82-36109
A SIMULATION MODEL OF AN ELECTRICITY GENERATING SYSTEM INCORPORATING WIND TURBINE PLANT
G. E. WHITTLE, E. A. BOSSANYI, P. D. DUNN, N. H. LIPMAN, P. J. MUSGROVE (Reading, University, Reading Berks., England), and C. MACLEAN (Reading, University, Reading, Berks.; Science and Engineering Research Council, Rutherford Appleton Laboratory, Didcot, Oxon England) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 545-554. refs

A82-36110
THE CAPACITY CREDIT OF WIND POWER - A NUMERICAL MODEL
B. MARTIN (Australian National University, Canberra, Australia) and M. DIESENDORF (Commonwealth Scientific and Industrial Research Organization, Div. of Mathematics and Statistics, Canberra, Australia) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 555-564. Research supported by the National Energy Research, Development and Demonstration Council. refs

A numerical probabilistic model was formulated to evaluate wind-derived electricity capacity credit as a function of grid penetration levels and the model's sensitivity to several parameters. The simulation included loss of load probability as the fraction of time capacity was less than load, the effective load carrying capacity which could be maintained at different levels of windpower penetration, and a standard wind turbine operating from 4-40

m/sec. Inputs comprised hourly load and wind data, individual unit capacities, forced outages, start-up times, etc. The available wind speed distributions were varied, as were the grid generating composition, the load distribution, and the WECS characteristics. Capacity credit was found to be equal to the average wind power for small WECS penetration, about 0.4 of the available wind energy at 20% penetration, and to reach a constant value at large penetrations. M.S.K.

A82-36111
WIND ENERGY IN ARGENTINA
R. A. BASTIANON (Research and Development Naval Service, Argentina) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Cranfield, Beds., England, BHRA Fluid Engineering, 1980, p. 565-570.

The potential for wind energy generation in Argentina is discussed, and ongoing projects are described. Anemometers have been installed in Patagonia to measure wind speeds at various locations and heights, and an experimental windmill consisting of vanes confined in a cylinder has been tested in a wind tunnel. The economic circumstances of Patagonia and the southern islands are discussed and it is argued that wind power would improve the situation there. The first serious attempt to build a high-performance wind turbine in Argentina is described. C.D.

A82-36112
A VERTICAL AXIS WIND ENERGY CONVERTER WITH STRAIGHT BLADES
H. G. REIMERDES (Aachen, Rheinisch-Westfaelische Technische Hochschule, Aachen, West Germany) In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Symposium sponsored by the British Hydromechanics Research Association. Cranfield, Beds., England, BHRA Fluid Engineering, 1980. 20 p. refs

Engineering considerations and the design of a two-bladed vertical axis wind turbine (VAWT) capable of producing 20 kW in a 7 m/sec wind are presented. An airfoil with a NACA 65(4)-021 profile was chosen, along with equal height-to-diameter ratio, operation at 5-15 m/sec, rotation at 21/min, and a maximum lift coefficient at rated speed. Using diagonal struts for support was found to produce both drag and propulsive forces, with the total drag calculated to be 0.026 for the blades. Wind tunnel tests on a scale model revealed that the required 20 kW could not be attained at the 7 m/sec level, but could at higher speeds, improving the total annual energy output by 20%. Further investigations covered mass forces, wind loading in different operational modes, starting and braking, and snow and ice loads. Wood was chosen as the main structural material to permit ready repairs in developing nations. M.S.K.

A82-36113
THE SOUTHERN CALIFORNIA DESERT WIND-ENERGY ASSESSMENT
E. X. BERRY (Atmospheric Research and Technology, Inc., Sacramento, CA), R. K. HAUSER, W. G. LANE (California State University, Chico, CA), and J. B. PARK, II In: International Symposium on Wind Energy Systems, 3rd, Lyngby, Denmark, August 26-29, 1980, Proceedings. Symposium sponsored by the British Hydromechanics Research Association. Cranfield, Beds., England, BHRA Fluid Engineering, 1980. 12 p. Research supported by the California Energy Commission.

The goals of the ongoing Project Windesert, which has established 25 new microprocessor-based meteorological stations in the southern California desert, are reported. Surface winds are being mapped for windpower applications, and determinations are being made of the level of detail required, the flows over complex terrain, and methodology. The Universal Mercator system was employed to define 10,000 sq km areas within the 90,000 sq km project area. In comparisons of data gathered at different sites, it was found that use of the zonal wind as a climatological base will underestimate the wind regime locally. No general rule of increase of wind speeds with height was implied by the data, and Rayleigh distributions were found to be invalid for predicting available wind power. Indications of enhanced winds over ridges and in troughs were documented. Finally, techniques for ensuring the success of a field-oriented wind survey are reported. M.S.K.

A82-36209
ECONOMIC ANALYSIS OF SMALL WIND-ENERGY CONVERSION SYSTEMS
B. N. HAACK (Ball State University, Muncie, IN) Applied Energy, vol. 11, May 1982, p. 51-60. refs

A computer simulation was developed for evaluating the economics of small wind energy conversion systems (SWECS). Input parameters consisted of initial capital investment, maintenance and operating costs, the cost of electricity from other sources, and the yield of electricity. Capital costs comprised the generator, tower, necessity for an inverter and/or storage batteries, and installation, in addition to interest on loans. Wind data recorded every three hours for one year in Detroit, MI was employed with a 0.16 power coefficient to extrapolate up to hub height as an example, along with 10 yr of use variances. A maximum return on investment was found to reside in using all the energy produced on site, rather than selling power to the utility. It is concluded that, based on a microeconomic analysis, SWECS are economically viable at present only where electric rates are inordinately high, such as in remote regions or on islands. M.S.K.

A82-36394
FRANCE'S SUPERFAST TRAIN
J. DUPUY (Societe Nationale des Chemins de Fer Francais, Paris, France) IEEE Spectrum, vol. 19, July 1982, p. 38-43. refs

Operational characteristics and the testing program for the high speed French National Railroad TGV passenger train service between Paris and southeastern France are described. The train speed is optimized at between 250-300 km/hr on routing that includes 390 km of new track and 36 km of conventional track. Each train set has two power units and eight passenger coaches which draw a total power of 6300 kW from 25 kV lines along the track. The cars were designed with a three meter base, a low carriage, rheostatic and disk brakes, and aerodynamic profiling to reduce air drag. Switching and warning signals are incorporated in the operators console, which receives coded signals from each 3000-m long segment of track to indicate broken rails, power-outs, or oncoming trains. M.S.K.

A82-37077#
USE OF PULTRUDED REINFORCED PLASTICS IN ENERGY GENERATION AND ENERGY RELATED APPLICATIONS
R. ANDERSON (Morrison Molded Fiberglass Co., Bristol, VA) In: Reinforced Plastics/Composites Institute, Annual Conference, 36th, Washington, DC, February 16-20, 1981, Preprints. New York, Society of the Plastics Industry, Inc., 1981 (Session 22-B). 3 p.

Applications of pultrusion-formed fiber-reinforced plastics (FRP) in the wind, oil, and coal derived energy industries are reviewed. FRP is noted to be a viable alternative to wood, aluminum, and steel for reasons of availability, price, and weight. Attention is given to the development of FRP wind turbine blades for the DOE 8 kW low cost, high reliability wind turbine program. The blades feature a NACA 23112 profile with a 15 in. chord on the system which was tested at Rocky Flats, CO. Fabricating the blades involved a plus and minus 45 deg roving orientation, a heavy fiber-glass nose piece to assure blade strength, and a separately manufactured foam core. Additional uses for FRP products have been found in the structural members of coal stack scrubbers using a vinyl ester resin in a fire retardant formulation, and as low cost, light weight sucker rods for deep well oil drilling. M.S.K.

A82-37549
DETERMINATION OF TEMPERATURE DISTRIBUTION IN THE FLOW OF A HOT GAS ON THE BASIS OF A SELF-REVERSED SPECTRAL LINE PROFILE [OPREDELENIE TEMPERATURNOGO RASPREDELENIIA V POTOKE GORIACHEGO GAZA PO KONTURU SAMOOBRASHCHENNOI SPEKTRAL'NOI LINII]
I. A. VASILEVA, A. V. ORLOV, A. S. URINSON (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR), S. GENDZHOV, and B. STEFANOV (B'lgarska Akademiia na Naukite, Institut po Elektronika, Sofia, Bulgaria) Akademiia Nauk SSSR, Doklady, vol. 264, no. 4, 1982, p. 853-856. In Russian. refs

The paper describes a method for determining the temperature distribution in a hot-gas flow on the basis of measurements of self-reversed spectral line profiles along one line of sight. A remotely controlled scanning monochromator was used to measure profiles of the resonance doublet of potassium at 7665 and 7699 A in a flow of combustion products of natural gas with a potassium additive in an MHD facility. Results show that this particular method of determining the temperature distribution in an inhomogeneous flow of radiating gas is particularly applicable to the study of boundary layers in MHD systems. B.J.

A82-37577
DESIGN AND PERFORMANCE CHARACTERISTICS OF A CW SUBSONIC HF CHEMICAL LASER WITH 120 W POWER OUTPUT
Z. BABAROGIC, I. BELIC, I. MENDAS, and M. TRTICA (Beograd, Univerzitet, Belgrade, Yugoslavia) Review of Scientific Instruments, vol. 53, July 1982, p. 949-951. refs

A transverse flow CW subsonic HF chemical laser is presented which provides up to 46 and 120 W CW output power when argon and helium, respectively, are used as diluent gases. The HF laser power is found to be approximately a linear function of the discharge electrical input power, indicating a constant electrical-to-laser power conversion efficiency of about 0.4%. The best achieved value of the chemical efficiency is about 1.2%, using argon as a diluent gas; the specific power corresponding to the maximum output power of 46 W is about 13 J/g. V.L.

A82-37627
THE EFFECT OF SULFUR ON THE ANODIC H2 /NI/ ELECTRODE IN FUSED LI2CO3-K2CO3 AT 650 C
W. M. VOGEL and S. W. SMITH (United Technologies Corp., Power Systems Div., South Windsor, CT) Electrochemical Society, Journal, vol. 129, July 1982, p. 1441-1445. Research supported by the U.S. Department of Energy. refs

The effects of sulfur on the reaction of H2 at a nickel anode in a molten Li2CO3-K2CO3 fuel cell at 650 C are investigated. Steady-state polarization curves for rotating Ni wires were determined in the presence of H2 gas containing varying amounts of H2S. In the absence of sulfur, the diffusion-limiting currents are observed to be only slightly larger than the limiting currents, while the introduction of H2S leads to a reduction in limiting currents which may be attributed to the poisoning of the Tafel reaction which converts molecular hydrogen into a metal hydride. Results suggest a saturation of the sulfur effect at an H2S/H2 pressure ratio of about 0.0001, although the sulfur-saturated Ni surface retains a finite activity for H2 oxidation. An approximate rate equation for H2 oxidation is also derived for small sulfur coverages. A.L.W.

A82-37971#
THE AGE OF FUSION - ON THE BRINK
S. WALTERS Mechanical Engineering, vol. 104, July 1982, p. 22-33.

The state of the art on magnetic fusion energy reactors is discussed in detail, and extensive diagrams of the different reactor designs as well as projected timetables for future advances in fusion capabilities are presented. During the 1980s, the scientific feasibility of fusion power will be tested in the US at the Tokamak Fusion Test Reactor (TFTR), and while the TFTR will not generate any electricity, it will be the first magnetic fusion system in the US capable of producing fusion energy in any significant quantity (30 MW). It will also be the first US system to use a deuterium-tritium fuel mixture, thus allowing studies to be conducted under reactor conditions. In addition, the TFTR incorporates a tritium-breeding blanket experiment, which will be used to test several features necessary for commercial fusion reactors. Another fusion reactor design showing promise is the magnetic mirror machine, a linear system utilizing magnetic mirrors to contain the plasma, and having several advantages over the tokamak-type machines. An example of this type of system, the Magnetic Mirror Test Facility, is scheduled to go into operation in the mid-1980s and will approach the energy break-even point, noting that recent tests of the superconducting magnet coils for this reactor achieved design expectations in all respects. N.B.

N82-22275# Rolls-Royce Ltd., Derby (England).
RELIABLE POWER
J. M. S. KEEN Feb. 1981 21 p Presented at Intern. Aircraft Maintenance Eng. Exhibition and Conf., Zurich, Feb. 1981
(PNR-90078) Avail: NTIS HC A02/MF A01

The Rolls Royce RB211 engine design is reviewed. The three shaft concept increases engine thrust and cuts fuel consumption. The highest thrust version of the RB211 cuts fuel consumption of Boeing 747's by 17%. The 535E4 blends turbine and bypass flows in a buried nozzle within a longer cowl. The resultant gases are exhausted through a single final nozzle. This device provides an automatic rematching of the engine cycle at climb ratings, thereby saving fuel and reducing turbine entry temperature. Reverse thrust is increased by up to 38% relative to an unmixed engine. The on-condition maintenance policy reduces costs without reducing safety. The reliability management program ensures the most cost effective maintainance schedule. Author (ESA)

N82-22327*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CROSS-LINKED POLYVINYL ALCOHOL FILMS AS ALKALINE BATTERY SEPARATORS
D. W. SHEIBLEY, M. A. MANZO, and O. D. GONZALEZ-SANABf .A Mar. 1982 19 p refs Presented at the 158th Meeting of the Electrochim. Soc., Hollywood, Fla., 5-10 Oct. 1980
(NASA-TM-82802; E-1141; NAS 1.15:82802) Avail: NTIS HC A02/MF A01 CSCL 07D

Cross-linking methods were investigated to determine their effect on the performance of polyvinyl alcohol (PVA) films as alkaline battery separators. The following types of cross-linked PVA films are discussed: (1) PVA-dialdehyde blends post-treated with an acid or acid periodate solution (two-step method) and (2) PVA-dialdehyde blends cross-linked during film formation (drying) by using a reagent with both aldehyde and acid functionality (one-step method). Laboratory samples of each cross-linked type of film were prepared and evaluated in standard separator screening tests. The pilot-plant batches of films were prepared and compared to measure differences due to the cross-linking method. The pilot-plant materials were then tested in nickel oxide - zinc cells to compare the two methods with respect to performance characteristics and cycle life. Cell test results are compared with those from tests with Celgard. Author

N82-22441# United Technologies Corp., South Windsor, Conn.
AC/DC POWER CONVERTER FOR BATTERIES AND FUEL CELLS Final Report
R. W. ROSATI, C. V. BANIC, F. J. KORNBRUST, J. L. PETERSON, and B. R. WILL Sep. 1981 231 p refs Sponsored by Electric Power Research Inst.
(Contract EPRI PROJ. 841-1)
(DE82-900867; EPRI-EM-2031) Avail: NTIS HC A11/MF A01

The results of a program to design an advanced power converter for use in battery energy storage and fuel cell generation systems in the 1980s are presented. The design analysis, including each major subsystem and component, various ways of optimizing a 14-MW wide-range converter, and the requirements for some of the converter components are described. An assessment of the

basic program is included, and a number of future program needs are identified.
M.D.K.

N82-22502# Curtiss-Wright Corp., Wood-Ridge, N.J.
HIGH-TEMPERATURE-TURBINE TECHNOLOGY PROGRAM. PHASE 2: TECHNOLOGY TEST AND SUPPORT STUDIES. TURBINE SPOOL TECHNOLOGY RIG CASCADE TESTS
Jun. 1981 95 p
(Contract DE-AC01-76ET-10348)
(DE81-030352; DOE/ET-10348/T3; FE-2291-76; CW-WR-76-020.76A) Avail: NTIS HC A05/MF A01

Integrated gas turbine combined cycle electric power generating systems offer the promise for using coal in an economic and environmentally acceptable manner. Powerplant efficiencies well above 40% may be achieved with gas turbine firing temperatures of 26000 F and higher, if the turbine cooling requirements are not excessive. Transpiration air cooling protects turbine components from the aggressive environment produced by the combustion of coal derived fuels. A new single stage, high work transpiration air cooled turbine was designed and fabricated for evaluation in a rotating test vehicle designated the turbine spool technology rig (TSTR). Prior to operating the TSTR, a cascade test program was conducted on a 10 vane sector to determine the cooling characteristics of these parts and to develop changes as required to assure satisfactory operation of the TSTR. The cascade program is described including several changes incorporated into the vanes.
DOE

N82-22649*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF ROTOR CONFIGURATION ON GUYED TOWER AND FOUNDATION DESIGNS AND ESTIMATED COSTS FOR INTERMEDIATE SITE HORIZONTAL AXIS WIND TURBINES
G. R. FREDERICK (Toledo Univ.), J. R. WINEMILLER, and J. M. SAVINO Mar. 1982 39 p refs
(NASA-TM-82804; DOE/NASA/20320-39; NAS 1.15:82804)
Avail: NTIS HC A03/MF A01 CSCL 10B

Three designs of a guyed cylindrical tower and its foundation for an intermediate size horizontal axis wind turbine generator are discussed. The primary difference in the three designs is the configuration of the rotor. Two configurations are two-blade rotors with teetering hubs - one with full span pitchable blades, the other with fixed pitch blades. The third configuration is a three-bladed rotor with a rigid hub and fixed pitch blades. In all configurations the diameter of the rotor is 38 meters and the axis of rotation is 30.4 meters above grade, and the power output is 200 kW and 400 kW. For each configuration the design is based upon for the most severe loading condition either operating wind or hurricane conditions. The diameter of the tower is selected to be 1.5 meters (since it was determined that this would provide sufficient space for access ladders within the tower) with guy rods attached at 10.7 meters above grade. Completing a design requires selecting the required thicknesses of the various cylindrical segments, the number and diameter of the guy rods. the number and size of soil anchors, and the size of the central foundation. The lower natural frequencies of vibration are determined for each design to ensure that operation near resonance does not occur. Finally, a cost estimate is prepared for each design. A preliminary design and cost estimate of a cantilever tower (cylindrical and not guyed) and its foundation is also presented for each of the three configurations.
Author

N82-22659*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HELICAL SCREW EXPANDER EVALUATION PROJECT Final Report
R. MCKAY 1 Mar. 1982 457 p refs
(Contract NAS7-100; DE-AI01-76ET-28329; EX-71-1-01-1000)
(NASA-CR-168803; JPL-PUB-82-5; NAS 1.26:168803; DOE/ET-28329/1) Avail: NTIS HC A20/MF A01 CSCL 10A

A one MW helical rotary screw expander power system for electric power generation from geothermal brine was evaluated. The technology explored in the testing is simple, potentially very efficient, and ideally suited to wellhead installations in moderate to high enthalpy, liquid dominated field. A functional one MW geothermal electric power plant that featured a helical screw expander was produced and then tested with a demonstrated average performance of approximately 45% machine efficiency over a wide range of test conditions in noncondensing, operation on two-phase geothermal fluids. The Project also produced a computer equipped data system, an instrumentation and contro van, and a 1000 kW variable load bank, all integrated into a test array designed for operation at a variety of remote test sites. Data are presented for the Utah testing and for the noncondensing phases of the testing in Mexico. Test time logged was 437 hours during the Utah tests and 1101 hours during the Mexico tests.
S.L.

N82-22661*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THEORY AND TESTS OF TWO-PHASE TURBINES
D. G. ELLIOTT 15 Mar. 1982 149 p refs
(Contract NAS7-100; DE-AI01-80ER-10614)
(NASA-CR-168834; JPL-PUB-81-105; NAS 1.26:168834; DOE/ER-10614/1) Avail: NTIS HC A07/MF A01 CSCL 10B

A theoretical model for two-phase turbines was developed. Apparatus was constructed for testing one- and two-stage turbines (using speed decrease from stage to stage). Turbines were tested with water and nitrogen mixtures and refrigerant 22. Nozzle efficiencies were 0.78 (measured) and 0.72 (theoretical) for water and nitrogen mixtures at a water/nitrogen mixture ratio of 68, by mass; and 0.89 (measured) and 0.84 (theoretical) for refrigerant 22 expanding from 0.02 quality to 0.28 quality. Blade efficiencies (shaft power before windage and bearing loss divided by nozzle jet power) were 0.63 (measured) and 0.71 (theoretical) for water and nitrogen mixtures and 0.62 (measured) and 0.63 (theoretical) for refrigerant 22 with a single stage turbine, and 0,70 (measured) and 0.85 (theoretical) for water and nitrogen mixtures with a two-stage turbine.
Author

N82-22671# Little (Arthur D.), Inc., Cambridge, Mass.
NEAR-TERM HIGH POTENTIAL COUNTIES FOR SWECS Final Report
W. C. OSBORN and W. T. DOWNEY Golden, Colo. Midwest Research Inst. Feb. 1981 103 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract EG-77-C-01-4042)
(SERI/TR-98282-11) Avail: NTIS HC A06/MF A01

Up-to-date market information to manufacturers of small wind energy conversion system (SWECS) to assist them in developing marketing strategies for their products are provided. The data are arranged in a format that permits rapid identification of a particular location or market segment for further investigation. Extensive backup information by state and county in state SWECS Market reports are appended. It is suggested that the information are useful to SWECS manufacturers for planning new marketing and advertising activities. Background information essential to market studies is synthesized and an initial framework to start such a study is provided.
Author

N82-23121*# Le Tourneau Coll., Longview, Tex.
ORBITER FUEL CELL IMPROVEMENT ASSESSMENT
R. E. JOHNSON *In* Houston Univ. The 1981 NASA ASEE Summer Fac. fellowship Program, Vol. 1 27 p 20 Aug. 1981 refs
Avail: NTIS HC A14/MF A01 CSCL 10A

The history of fuel cells and the theory of fuel cells is given. Expressions for thermodynamic and electrical efficiencies are developed. The voltage losses due to electrode activation, ohmic resistance and ionic diffusion are discussed. Present limitations of the Orbiter Fuel Cell, as well as proposed enhancements, are given. These enhancements are then evaluated and recommendations are given for fuel cell enhancement both for short-range as well as long-range performance improvement. Estimates of reliability and cost savings are given for enhancements where possible.
Author

N82-23678*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PARAMETRIC PERFORMANCE ANALYSIS OF STEAM-INJECTED GAS TURBINE WITH A THERMIONIC-ENERGY-CONVERTER-LINED COMBUSTOR
Y. K. CHOO and R. K. BURNS Feb. 1982 21 p refs
(NASA-TM-82736; E-1048; NAS 1.15:82736) Avail: NTIS HC A02/MF A01 CSCL 10B

The performance of steam-injected gas turbines having combustors lined with thermionic energy converters (STIG/TEC systems) was analyzed and compared with that of two baseline systems; a steam-injected gas turbine (without a TEC-lined combustor) and a conventional combined gas turbine/steam turbine cycle. Common gas turbine parameters were assumed for all of the systems. Two configurations of the STIG/TEC system were investigated. In both cases, steam produced in an exhaust-heat-recovery boiler cools the TEC collectors. It is then injected into the gas combustion stream and expanded through the gas turbine. The STIG/TEC system combines the advantage of gas turbine steam injection with the conversion of high-temperature combustion heat by TEC's. The addition of TEC's to the baseline steam-injected gas turbine improves both its efficiency and specific power. Depending on system configuration and design parameters, the STIG/TEC system can also achieve higher efficiency and specific power than the baseline combined cycle. Author

N82-23679*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF LIGHTNING ACCOMMODATION SYSTEMS FOR WIND-DRIVEN TURBINE ROTORS Final Report
H. BANKAITIS Mar. 1982 49 p refs
(Contract DE-AI01-76ET-20320)
(NASA-TM-82784; E-1116; DOE/NASA/20320-37; NAS 1.15:82784) Avail: NTIS HC A03/MF A01 CSCL 10B

Wind-driven turbine generators are being evaluated as an alternative source of electric energy. Areas of favorable location for the wind-driven turbines (high wind density) coincide with areas of high incidence of thunderstorm activity. These locations, coupled with the 30-m or larger diameter rotor blades, make the wind-driven turbine blades probable terminations for lightning strikes. Several candidate systems of lightning accommodation for composite-structural-material blades were designed and their effectiveness evaluated by submitting the systems to simulated lightning strikes. The test data were analyzed and system design were reviewed on the basis of the analysis. T.M.

N82-23684*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND TURBINE DYNAMICS
R. W. THRESHER, ed. (Oregon State Univ., Corvallis) May 1981 422 p refs Workshop held in Cleveland 24-26 Feb. 1981 Sponsored in part by DOE
(NASA-CP-2185; NAS 1.55:2185; CONF-810226; SERI/CP-635-1238) Avail: NTIS HC A18/MF A01 CSCL 10B

Recent progress in the analysis and prediction of the dynamic behavior of wind turbine generators is discussed. The following areas were addressed: (1) the adequacy of state of the art analysis tools for designing the next generation of wind power systems; (2) the use of state of the art analysis tools designers; and (3) verifications of theory which might be lacking or inadequate. Summaries of these informative discussions as well as the questions and answers which followed each paper are documented in the proceedings.

N82-23685*# Oregon State Univ., Corvallis. Dept. of Mechanical Engineering.
AERODYNAMIC POTPOURRI
R. E. WILSON *In* NASA. Lewis Research Center Wind Turbine Dyn. p 3-7 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Aerodynamic developments for vertical axis and horizontal axis wind turbines are given that relate to the performance and aerodynamic loading of these machines. Included are: (1) a fixed wake aerodynamic model of the Darrieus vertical axis wind turbine; (2) experimental results that suggest the existence of a laminar flow Darrieus vertical axis turbine; (3) a simple aerodynamic model for the turbulent windmill/vortex ring state of horizontal axis rotors; and (4) a yawing moment of a rigid hub horizontal axis wind turbine that is related to blade coning. Author

N82-23686*# Toledo Univ., Ohio. Dept. of Mechanical Engineering.
AERODYNAMIC PERFORMANCE PREDICTION OF HORIZONTAL AXIS WIND TURBINES
D. R. JENG, T. G. KEITH, and A. ALIAKBARKHANAFJEH *In* NASA. Lewis Research Center Wind Turbine Dyn. p 9-18 May 1981 refs
(Contract NCC3-5)
Avail: NTIS HC A18/MF A01 CSCL 10B

A new method for calculating the aerodynamic performance of horizontal axis wind turbines is described. The method, entitled the helical vortex method, directly calculates the local induced velocity due to helical vortices that originate at the rotor blade. Furthermore, the method does not require a specified circulation distribution. Results of the method are compared to similar results obtained from Wilson PROP code methods as well as to existing experimental data taken from a Mod-O wind turbine. It is shown that results of the proposed method agree well with experimental values of the power output both near cut-in and at rated wind speeds. Further, it is found that the method does not experience some of the numerical difficulties encountered by the PROP code when run at low wind velocities. Author

N82-23687*# Institut de Recherche de l'Hydro-Quebec, Varennes.
DOUBLE-MULTIPLE STREAMTUBE MODEL FOR DARRIEUS IN TURBINES
I. PARASCHIVOIU *In* NASA. Lewis Research Center Wind Turbine Dyn. p 19-25 May 1981 refs Sponsored in part by IREQ
Avail: NTIS HC A18/MF A01 CSCL 10B

An analytical model is proposed for calculating the rotor performance and aerodynamic blade forces for Darrieus wind turbines with curved blades. The method of analysis uses a multiple-streamtube model, divided into two parts: one modeling the upstream half-cycle of the rotor and the other, the downstream half-cycle. The upwind and downwind components of the induced velocities at each level of the rotor were obtained using the principle of two actuator disks in tandem. Variation of the induced velocities in the two parts of the rotor produces larger forces in the upstream zone and smaller forces in the downstream zone. Comparisons of the overall rotor performance with previous methods and field test data show the important improvement obtained with the present model. The calculations were made using the computer code CARDAA developed at IREQ. The double-multiple streamtube model presented has two major advantages: it requires a much shorter computer time than the three-dimensional vortex model and is more accurate than multiple-streamtube model in predicting the aerodynamic blade loads. Author

N82-23688*# United Technologies Corp., East Hartford, Conn. Aeromechanics Research Section.
THE UTRC WIND ENERGY CONVERSION SYSTEM PERFORMANCE ANALYSIS FOR HORIZONTAL AXIS WIND TURBINES (WECSPER)
T. A. EGOLF and A. J. LANDGREBE *In* NASA. Lewis Research Center Wind Turbine Dyn. p 27-34 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

The theory for the UTRC Energy Conversion System Performance Analysis (WECSPER) for the prediction of horizontal axis wind turbine performance is presented. Major features of the analysis are the ability to: (1) treat the wind turbine blades as lifting lines with a prescribed wake model; (2) solve for the wake-induced inflow and blade circulation using real nonlinear airfoil data; and (3) iterate internally to obtain a compatible wake transport

velocity and blade loading solution. This analysis also provides an approximate treatment of wake distortions due to tower shadow or wind shear profiles. Finally, selected results of internal UTRC application of the analysis to existing wind turbines and correlation with limited test data are described. Author

N82-23689*# Young Energy Systems, Dennisport, Mass.
THE VELOCITY FIELD OF A SYSTEM OF UNSTEADY CYCLOIDAL VORTICIES
B. J. YOUNG *In* NASA. Lewis Research Center Wind Turbine Dyn. p 35-40 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

An essential difference between two-dimensional and three-dimensional models of cycloidal rotors, the presence of unsteady trailing cycloidal vorticies in the wake, was studied. The velocity induced by these vorticies is the primary mechanism producing flow retardation for low span/radius ratio, finite blade number rotors. Results of using idealized rigid wake model of finite blade cycloidal rotors to investigate some cycloidal rotor problems are presented. Author

N82-23691*# University of Western Ontario, London. Dept. of Engineering Science.
ON THE WAKE OF A DARRIEUS TURBINE
T. E. BASE, P. PHILLIPS, G. ROBERTSON, and E. S. NOWAK *In* NASA. Lewis Research Center Wind Turbine Dyn. p 51-66 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

The theory and experimental measurements on the aerodynamic decay of a wake from high performance vertical axis wind turbine are discussed. In the initial experimental study, the wake downstream of a model Darrieus rotor, 28 cm diameter and a height of 45.5 cm, was measured in a Boundary Layer Wind Tunnel. The wind turbine was run at the design tip speed ratio of 5.5. It was found that the wake decayed at a slower rate with distance downstream of the turbine, than a wake from a screen with similar troposkein shape and drag force characteristics as the Darrieus rotor. The initial wind tunnel results indicated that the vertical axis wind turbines should be spaced at least forty diameters apart to avoid mutual power depreciation greater than ten per cent.
Author

N82-23692*# Sandia Labs., Albuquerque, N. Mex.
RECENT DARRIEUS VERTICAL AXIS WIND TURBINE AERODYNAMICAL EXPERIMENTS AT SANDIA NATIONAL LABORATORIES
P. C. KLIMAS *In* NASA. Lewis Research Center Wind Turbine Dyn. p 67-76 May 1981 refs
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A18/MF A01 CSCL 10B

Experiments contributing to the understanding of the aerodynamics of airfoils operating in the vertical axis wind turbine (VAWT) environment are described. These experiments are ultimately intended to reduce VAWT cost of energy and increase system reliability. They include chordwise pressure surveys, circumferential blade acceleration surveys, effects of blade camber, pitch and offset, blade blowing, and use of sections designed specifically for VAWT application. Author

N82-23693*# Purdue Univ., Lafayette, Ind.
PERFORMANCE OF WIND TURBINES IN A TURBULENT ATMOSPHERE
R. M. SUNDAR and J. P. SULLIVAN *In* NASA. Lewis Research Center Wind Turbine Dyn. p 79-86 May 1981 refs Sponsored in part by DOE
Avail: NTIS HC A18/MF A01 CSCL 10B

The effect of atmospheric turbulence on the power fluctuations of large wind turbines was studied. The significance of spatial non-uniformities of the wind is emphasized. The turbulent wind with correlation in time and space is simulated on the computer by Shinozukas method. The wind turbulence is modelled according to the Davenport spectrum with an exponential spatial correlation function. The rotor aerodynamics is modelled by simple blade element theory. Comparison of the spectrum of power output signal between 1-D and 3-D turbulence, shows the significant power fluctuations centered around the blade passage frequency.
Author

N82-23695*# Oregon State Univ., Corvallis. Dept. of Mechanical Engineering.
WIND TURBULENCE INPUTS FOR HORIZONTAL AXIS WIND TURBINES
W. E. HOLLEY, R. W. THRESHER, and S. R. LIN *In* NASA. Lewis Research Center Wind Turbine Dyn. p 101-112 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Wind turbine response characteristics in the presence of atmospheric turbulence was predicted using two major modeling steps. First, the important atmospheric sources for the force excitations felt by the wind turbine system were identified and characterized. Second, a dynamic model was developed which describes how these excitations are transmitted through the structure and power train. The first modeling step, that of quantifying the important excitations due to the atmospheric turbulence was established. The dynamic modeling of the second step was undertaken separately. Author

N82-23696*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATIONS OF THE DOE/NASA WIND TURBINE ENGINEERING INFORMATION SYSTEM
H. E. NEUSTADTER and D. A. SPERA *In its* Wind Turbine Dyn. p 113-120 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

A statistical analysis of data obtained from the Technology and Engineering Information Systems was made. The systems analyzed consist of the following elements: (1) sensors which measure critical parameters (e.g., wind speed and direction, output power, blade loads and component vibrations); (2) remote multiplexing units (RMUs) on each wind turbine which frequency-modulate, multiplex and transmit sensor outputs; (3) on-site instrumentation to record, process and display the sensor output; and (4) statistical analysis of data. Two examples of the capabilities of these systems are presented. The first illustrates the standardized format for application of statistical analysis to each directly measured parameter. The second shows the use of a model to estimate the variability of the rotor thrust loading, which is a derived parameter. Author

N82-23698*# DAF Indal Ltd., Mississauga (Ontario).
PERFORMANCE TESTING OF A 50 KW VAWT IN A BUILT-UP ENVIRONMENT
L. A. SCHIENBEIN *In* NASA. Lewis Research Center Wind Turbine Dyn. p 129-138 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

The results of performance tests of a DAF Indal 50 kW vertical axis wind turbine are presented. Results of limited free stream turbulence and vertical wind shear measurements at the site are also presented. The close agreement between measured and predicted energy outputs, required to verify the wind turbine power output performance relationship, was not attained. A discussion is presented of factors that may have contributed to the lack of better agreement. Author

N82-23700*# Browning Engineering Corp., Hanover, N.H.
THE HYDRAULIC WINDMILL
J. A. BROWING *In* NASA. Lewis Research Center Wind Turbine Dyn. p 151-154 May 1981
(Contract DE-FG01-80IR-10320)
Avail: NTIS HC A18/MF A01 CSCL 10B

An hydraulic windmill is described. It pumps pressurized oil from rotor shaft level to the ground where a motor generator produces electricity. Alternatively, the useful output may be heat. Rotor speed is governed by a flow valve. Over pressure, the result of high wind velocity, rotates the tail to move the rotor blades out-of-the-wind. Loss of oil pressure causes a brake to

close as well as to swing the tail to its maximum distance from the rotor plane. Author

N82-23709*# Rockwell International Corp., Canoga Park, Calif. Energy Systems Group.
EXPERIENCE ON THE USE OF MOSTAB-HFW COMPUTER CODE FOR HORIZONTAL-AXIS WIND TURBINES
Y. Y. YU *In* NASA. Lewis Research Center Wind Turbine Dyn. p 221-223 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Three topics are covered dealing with the frequencies of a rotating beam, the use of the fundamental mode of a uniform cantilever beam, and the analysis of resonance dwell. Immensely high peak loads were generated by the code for resonance dwell indicating further need for including structural damping and for transient analysis capability. The effect of structural damping, newly incorporated in the code, is described. T.M.

N82-23710*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF UPWIND AND DOWNWIND ROTOR OPERATION OF THE DOE/NASA 100-KW MOD-0 WIND TURBINE
J. C. GLASGOW, D. R. MILLER, and R. D. CORRIGAN *In its* Wind Turbine Dyn. p 225-234 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Tests were conducted on a 38m diameter horizontal axis wind turbine, which had first a rotor downwind of the supporting truss tower and then upwind of the tower. Aside from the placement of the rotor and the direction of rotation of the drive train, the wind turbine was identical for both tests. Three aspects of the test results are compared: rotor blade bending loads, rotor teeter response, and nacelle yaw moments. As a result of the tests, it is shown that while mean flatwise bending moments were unaffected by the placement of the rotor, cyclic flatwise bending tended to increase with wind speed for the downwind rotor while remaining somewhat uniform with wind speed for the upwind rotor, reflecting the effects of increased flow disturbance for downwind rotor. Rotor teeter response was not significantly affected by the rotor location relative to the tower, but appears to reflect reduced teeter stability near rated wind speed for both configurations. Teeter stability appears to return above rated wind speed, however. Nacelle yaw moments are higher for the upwind rotor but do not indicate significant design problems for either configuration. T.M.

N82-23711*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REVIEW OF RESONANCE RESPONSE IN LARGE HORIZONTAL-AXIS WIND TURBINES
T. L. SULLIVAN *In its* Wind Turbine Dyn. p 237-244 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Field operation of the Mod-0 and Mod-1 wind turbines is described. Operational experience shows that 1 per rev excitation exists in the drive train, high aerodynamic damping prevents resonance response of the blade flatwise modes, and teetering the hub substantially reduces the chordwise blade response to odd harmonic excitation. These results can be used by designer as a guide to system frequency placement. In addition it is found that present analytical techniques can accurately predict wind turbine natural frequencies. T.M.

N82-23712*# Rockwell International Corp., Golden, Colo. Energy Systems Group.
SWECS TOWER DYNAMICS ANALYSIS METHODS AND RESULTS
A. D. WRIGHT, J. H. SEXTON, C. P. BUTTERFIELD, and R. M. THRESHER (Oregon State Univ., Corvallis) *In* NASA. Lewis Research Center Wind Turbine Dyn. p 245-253 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Several different tower dynamics analysis methods and computer codes were used to determine the natural frequencies and mode shapes of both guyed and freestanding wind turbine towers. These analysis methods are described and the results for two types of towers, a guyed tower and a freestanding tower, are shown. The advantages and disadvantages in the use of and the accuracy of each method are also described. T.M.

N82-23715*# Ventus Energy Corp., La Crescenta, Calif.
PASSIVE CYCLIC PITCH CONTROL FOR HORIZONTAL AXIS WIND TURBINES
G. W. BOTTRELL *In* NASA. Lewis Research Center Wind Turbine Dyn. p 271-275 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

A flexible rotor concept, called the balanced pitch rotor, is described. The system provides passive adjustment of cyclic pitch in response to unbalanced pitching moments across the rotor disk. Various applications are described and performance predictions are made for wind shear and cross wind operating conditions. Comparisons with the teetered hub are made and significant cost savings are predicted. T.M.

N82-23719*# Sandia Labs., Albuquerque, N. Mex.
VERTICAL AXIS WIND TURBINE DRIVE TRAIN TRANSIENT DYNAMICS
D. B. CLAUSS and T. G. CARNE *In* NASA. Lewis Research Center Wind Turbine Dyn. p 305-314 May 1982 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Start up of a vertical axis wind turbine causes transient torque oscillations in the drive train with peak torques which may be over two and one half times the rated torque of the turbine. A computer code, based on a lumped parameter model of the drive train, was developed and tested for the low cost 17 meter turbine; the results show excellent agreement with field data. The code was used to predict the effect of a slip clutch on transient torque oscillations. It was demonstrated that a slip clutch located between the motor and brake can reduce peak torques by thirty eight percent. T.M.

N82-23720*# Power Technologies, Inc., Schenectady, N. Y.
DYNAMICS AND STABILITY OF WIND TURBINE GENERATORS
E. N. HINRICHSEN and P. J. NOLAN *In* NASA. Lewis Research Center Wind Turbine Dyn. p 315-324 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Synchronous and induction generators are considered. A comparison is made between wind turbines, steam, and hydro units. The unusual phenomena associated with wind turbines are emphasized. The general control requirements are discussed, as well as various schemes for torsional damping such as speed sensitive stabilizer and blade pitch control. Integration between adjacent wind turbines in a wind farm is also considered. T.M.

N82-23721*# Kaman Aerospace Corp., Bloomfield, Conn.
KAMAN 40 KW WIND TURBINE GENERATOR - CONTROL SYSTEM DYNAMICS
R. PERLEY *In* NASA. Lewis Research Center Wind Turbine Dyn. p 325-332 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

The generator design incorporates an induction generator for application where a utility line is present and a synchronous generator for standalone applications. A combination of feed forward and feedback control is used to achieve synchronous speed prior to connecting the generator to the load, and to control the power level once the generator is connected. The dynamics of the drive train affect several aspects of the system operation. These were analyzed to arrive at the required shaft stiffness. The rotor parameters that affect the stability of the feedback control loop vary considerably over the wind speed range encountered. Therefore, the controller gain was made a function of wind speed in order to maintain consistent operation over the whole wind speed range. The velocity requirement for the pitch control mechanism is related to the nature of the wind gusts to be encountered, the dynamics of the system, and the acceptable power fluctuations and generator dropout rate. A model was

developed that allows the probable dropout rate to be determined from a statistical model of wind gusts and the various system parameters, including the acceptable power fluctuation. T.M.

N82-23722*# New Mexico Univ., Albuquerque. Engineering Research Inst.
AUTOMATIC CONTROL ALGORITHM EFFECTS ON ENERGY PRODUCTION
G. M. MCNERNEY *In* NASA. Lewis Research Center Wind Turbine Dyn. p 333-342 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

A computer model was developed using actual wind time series and turbine performance data to simulate the power produced by the Sandia 17-m VAWT operating in automatic control. The model was used to investigate the influence of starting algorithms on annual energy production. The results indicate that, depending on turbine and local wind characteristics, a bad choice of a control algorithm can significantly reduce overall energy production. The model can be used to select control algorithms and threshold parameters that maximize long term energy production. The results from local site and turbine characteristics were generalized to obtain general guidelines for control algorithm design. T.M.

N82-23723*# Michigan State Univ., East Lansing.
EFFECT OF WIND TURBINE GENERATOR MODEL AND SITING ON WIND POWER CHANGES OUT OF LARGE WECS ARRAYS
R. A. SCHLEUTER, G. L. PARK, M. LOTFALIAN, J. DORSEY, and H. SHAYANFAR *In* NASA. Lewis Research Center Wind Turbine Dyn. p 343-352 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Methods of reducing the WECS generation change through selection of the wind turbine model for each site, selection of an appropriate siting configuration, and wind array controls are discussed. An analysis of wind generation change from an echelon and a farm for passage of a thunderstorm is presented. Reduction of the wind generation change over ten minutes is shown to reduce the increase in spinning reserve, unloadable generation and load following requirements on unit commitment when significant WECS generation is present and the farm penetration constraint is satisfied. Controls on the blade pitch angle of all wind turbines in an array or a battery control are shown to reduce both the wind generation change out of an array and the effective farm penetration in anticipation of a storm so that the farm penetration constraint may be satisfied. T.M.

N82-23724*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MEASURED AND CALCULATED CHARACTERISTICS OF WIND TURBINE NOISE
G. C. GREENE *In* NASA. Lewis Research Center Wind Turbine Dyn. p 355-362 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

The results of an analytical and experimental investigation of wind turbine noise are presented. Noise calculations indicate that for configurations with the rotor downwind of the support tower, the primary source of noise is the rapid change in rotor loadings which occurs as the rotor passes through the tower wake. Noise measurements are presented for solid and truss type tower models with both upwind and downwind rotors. Upwind rotor configurations are shown to be significantly quieter than downwind configurations. The model data suggest that averaged noise measurements and noise calculations based on averaged tower wake characteristics may not accurately represent the impulsive noise characteristics of downwind rotor configurations. Author

N82-23725*# Wichita State Univ., Kans. Wind Energy Lab.
DYNAMICS OF WAKES DOWNSTREAM OF WIND TURBINE TOWERS
M. H. SNYDER and W. H. WENTZ, JR. *In* NASA. Lewis Research Center Wind Turbine Dyn. p 369-373 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

The near field wakes downstream of circular cylinders and of 12 sided cylinders were surveyed in a wind tunnel. Local velocity and velocity deficit diagrams are presented. The variation of turbulence in the wake was surveyed and the frequency of the periodic component of wake motion was determined. Differences between wakes of circular cylinders and of 12 sided cylinders are discussed. Also effects of strakes, orientation of the 12 sided cylinders, and rounding of the corners are noted. Author

N82-23726*# Midwest Research Inst., Golden, Colo. Wind Energy Branch.
ACOUSTIC NOISE GENERATION BY THE DOE/NASA MOD-1 WIND TURBINE
N. D. KELLEY *In* NASA. Lewis Research Center Wind Turbine Dyn. p 375-387 May 1981 refs Sponsored in part by DOE
Avail: NTIS HC A18/MF A01 CSCL 10B

The results of a series of measurements taken over the past year of the acoustic emissions from the DOE/NASA MOD-1 Wind Turbine show the maximum acoustic energy is concentrated in the low frequency range, often below 100 Hz. The temporal as well as the frequency characteristics of the turbine sounds have been shown to be important since the MOD-1 is capable of radiating both coherent and incoherent noise. The coherent sounds are usually impulsive and are manifested in an averaged frequency domain plot as large numbers of discrete energy bands extending from the blade passage frequency to beyond 50 Hz on occasion. It is these impulsive sounds which are identified as the principal source of the annoyance to a dozen families living within 3 km of the turbine. The source of the coherent noise appears to be the rapid, unsteady blade loads encountered as the blade passes through the wake of the tower structure. Annoying levels are occasionally reached at nearby homes due to the interaction of the low frequency, high energy peaks in the acoustic impulses and the structural modes of the homes as well as by direct radiation outdoors. The peak levels of these impulses can be enhanced or subdued through complete propagation. Author

N82-23727*# General Electric Co., Schenectady, N. Y.
GE MOD-1 NOISE STUDY
R. J. WELLS *In* NASA. Lewis Research Center Wind Turbine Dyn. p 389-395 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Noise studies of the MOD-1 Wind Turbine Generator are summarized, and a simple mathematical noise is presented which is adequate to correlate the sound levels found near the machine. A simple acoustic measure is suggested for use in evaluating far field sound levels. Use of this measure as input to a currently available sound complaint prediction program is discussed. Results of a recent statistical survey relative to the far field variation of this acoustic measure because of atmospheric effects are described. Author

N82-23728*# Pennsylvania State Univ., University Park. Dept. of Meteorology.
ENHANCEMENT OF FAR FIELD SOUND LEVELS BY REFRACTIVE FOCUSING
D. W. THOMSON and S. D. ROTH *In* NASA. Lewis Research Center Wind Turbine Dyn. p 397-400 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

The enhancement of sound pressure levels resulting from refractive focusing was calculated for meteorological conditions representative of those observed at the MOD-1 site near Boone, N.C. The results show that 10 to 20dB enhancements can occur over ranges of several hundred meters. Localized enhancements in excess of 20dB can occur but will probably be of limited duration as a consequence of normal temporally varying meteorological conditions. Author

N82-23729*# Massachusetts Inst. of Tech., Cambridge.
PREDICTION OF LOW FREQUENCY AND IMPULSIVE SOUND RADIATION FROM HORIZONTAL AXIS WIND TURBINES
R. MARTINEZ, S. E. WIDNALL, and W. L. HARRIS *In* NASA. Lewis Research Center Wind Turbine Dyn. p 401-409 May 1981 refs Sponsored in part by Midwest Research Inst.
Avail: NTIS HC A18/MF A01 CSCL 10B

Theoretical models to predict the radiation of low frequency and impulsive sound from horizontal axis wind turbines due to three sources: (1) steady blade loads; (2) unsteady blade loads due to operation in a ground shear; (3) unsteady loads felt by the blades as they cross the tower wake. These models are then used to predict the acoustic output of MOD-1, the large wind turbine operated near Boone, N.C. Predicted acoustic time signals are compared to those actually measured near MOD-1 and good agreement is obtained. Author

N82-23730*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE NASA-LERC WIND TURBINE SOUND PREDICTION CODE
L. A. VITERNA *In its* Wind Turbine Dyn. p 411-418 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Since regular operation of the DOE/NASA MOD-1 wind turbine began in October 1979 about 10 nearby households have complained of noise from the machine. Development of the NASA-LeRC with turbine sound prediction code began in May 1980 as part of an effort to understand and reduce the noise generated by MOD-1. Tone sound levels predicted with this code are in generally good agreement with measured data taken in the vicinity MOD-1 wind turbine (less than 2 rotor diameters). Comparison in the far field indicates that propagation effects due to terrain and atmospheric conditions may be amplifying the actual sound levels by about 6 dB. Parametric analysis using the code has shown that the predominant contributions to MOD-1 rotor noise are: (1) the velocity deficit in the wake of the support tower; (2) the high rotor speed; and (3) off column operation. Author

N82-23731*# Boeing Vertol Co., Philadelphia, Pa.
NOISE GENERATION OF UPWIND MOTOR WIND TURBINE GENERATORS
R. H. SPENCER *In* NASA. Lewis Research Center Wind Turbine Dyn. p 419-423 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

Noise sources of wind turbines with rotors upstream of the support structure are discussed along with methodology for sound level prediction. Estimated noise levels for the MOD-2 wind turbine are presented operating in both the upwind and downwind configurations. Results indicate that upwind rotor configurations may be advantageous from an acoustical standpoint. Author

N82-23732*# Hamilton Standard, Windsor Locks, Conn.
DOWNWIND ROTOR HORIZONTAL AXIS WIND TURBINE NOISE PREDICTION
F. B. METZGER and R. J. KLATTE *In* NASA. Lewis Research Center Wind Turbine Dyn. p 425-430 May 1981 refs Sponsored in part by NASA. Langley Research Center, Midwest Research Inst., and Wichita State Univ.
Avail: NTIS HC A18/MF A01 CSCL 10B

NASA and industry are currently cooperating in the conduct of extensive experimental and analytical studies to understand and predict the noise of large, horizontal axis wind turbines. This effort consists of (1) obtaining high quality noise data under well controlled and documented test conditions, (2) establishing the annoyance criteria for impulse noise of the type generated by horizontal axis wind turbines with rotors downwind of the support tower, (3) defining the wake characteristics downwind of the axial location of the plane of rotation, (4) comparing predictions with measurements made by use of wake data, and (5) comparing predictions with annoyance criteria. The status of work by Hamilton Standard in the above areas which was done in support of the cooperative NASA and industry studies is briefly summarized. Author

N82-23733*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND TURBINE ACOUSTIC STANDARDS
D. G. STEPHENS, K. P. SHEPHERD (Bionetics Corp., Hampton, Va.), and F. GROSVELD (Bionetics Corp., Hampton, Va.) *In* NASA Lewis Research Center Wind Turbine Dyn. p 431-435 May 1981 refs
Avail: NTIS HC A18/MF A01 CSCL 10B

A program is being conducted to develop noise standards for wind turbines which minimize annoyance and which can be used to design specifications. The approach consists of presenting wind turbine noise stimuli to test subjects in a laboratory listening chamber. The responses of the subjects are recorded for a range of stimuli which encompass the designs, operating conditions, and ambient noise levels of current and future installations. Results to date have established the threshold of detectability for a range of impulsive stimuli of the type associated with blade/tower wake interactions. The status of the ongoing psychoacoustic tests, the subjective data, and the approach to the development of acoustic criteria/standards are described. Author

N82-23749# JBF Scientific Corp., Wilmington, Mass.
SMALL-WIND-SYSTEMS APPLICATION ANALYSIS. TECHNICAL REPORT AND EXECUTIVE SUMMARY
Jun. 1981 384 p refs Sponsored in part by Rockwell International Corp., Golden, Colo.
(Contract DE-AC04-76DP-03533)
(DE82-003748; RFP-3147/2) Avail: NTIS HC A17/MF A01

A small wind energy conversion systems (SWECS) analysis was conducted to estimate the potential market for SWEC, or wind machines smaller than 100 kW for five selected applications. The goals were to aid manufacturers in attaining financing by convincing venture capital investors of the potential of SWECS and to aid government planners in allocating R and D expenditures that will effectively advance SWECS commercialization. Based on these goals, the study: (1) provides a basis for assisting the DOE in planning R and D programs that will advance the state of SWECS industry; (2) quantifies estimates of market size vs. installed system cost to enable industry to plan expansion of capacity and product lines; (3) identifies marketing strategies for industry to use in attaining financing from investors and in achieving sales goals; and (4) provides DOE with data that will assist in determining actions, incentives, and/or legislation required to achieve a commercially viable SWECS industry. The five applications were selected through an initial screening and priority-ranking analysis. The year of analysis was 1985, but all dollar amounts, such as fuel costs, are expressed in 1980 dollars. The five SWECS applications investigated were farm residences, non-farm residences, rural electric cooperatives, feed grinders, and remote communities. DOE

N82-23775# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
GENERAL INTRODUCTION TO WIND ENERGY CONVERSION
O. DEVRIES Apr. 1981 128 p refs Presented at Von Karman Inst. for Fluid Dyn. Lecture Series No. 9 on Wind Energy Conversion Devices, Rhode-Saint-Genese, Belgium, 1-5 Jun. 1981
(NLR-MP-81014-U) Avail: NTIS HC A07/MF A01

Wind turbine and wind concentrator concepts are reviewed and the aerodynamic characteristics of wind turbines are discussed. The parameters which determine choice of conversion scheme, e.g., wind data, turbine control, conversion system, structural, dynamic and cost aspects, and environmental impediments, are considered. Design criteria are surveyed and the desirability of formulating building codes for wind energy conversion projects is stressed. Author (ESA)

N82-24079*# National Aeronautics and Space Administration. Pasadena Office, Calif.
MHD ELECTRICAL GENERATOR Patent Application
D. J. FITZGERALD, inventor (to NASA) (JPL, California Inst. of Technology, Pasadena) 14 Feb. 1982 13 p
(Contract NAS7-100)
(NASA-CASE-NPO-15399-1; US-PATENT-APPL-SN-330612)
Avail: NTIS HC A02/MF A01 CSCL 20I

An MHD (magnetohydrodynamic) electric generator is provided which is of high efficiency and which can operate in a closed cycle with minimal moving parts for unattended applications. The generator includes a porous tungsten element heated by a heat source and a system for passing primarily pure cesium vapor into the porous element, to produce contact ionization of the cesium with a higher percentage of ions than can be sustained. The highly ionized cesium vapor, and corresponding numbers of electrons from the tungsten element, recombine to produce a much higher temperature as the cesium flows through a tube past an MHD converter that generates electricity, and into a cool end of the tube where the cesium is cooled to a liquid temperature. The liquid can be recirculated by passing it through capillary passages extending towards the location where cesium vapor enters the porous tungsten element. NASA

N82-24289*# AiResearch Mfg. Co., Phoenix, Ariz.
STUDY OF REACTOR BRAYTON POWER SYSTEMS FOR NUCLEAR ELECTRIC SPACECRAFT
28 Sep. 1979 169 p refs Prepared for JPL, Pasadena, Calif. Original contains color illustrations
(Contract JPL-955008)
(NASA-CR-168942; NAS 1.26:166942; AIRESEARCH-31-3321)
Avail: NTIS HC A08/MF A01 CSCL 21C

The feasibility of using Brayton power systems for nuclear electric spacecraft was investigated. The primary performance parameters of systems mass and radiator area were determined for systems from 100 to 1000 kW sub e. Mathematical models of all system components were used to determine masses and volumes. Two completely independent systems provide propulsion power so that no single-point failure can jeopardize a mission. The waste heat radiators utilize armored heat pipes to limit meteorite puncture. The armor thickness was statistically determined to achieve the required probability of survival. A 400 kW sub e reference system received primary attention as required by the contract. The components of this system were defined and a conceptual layout was developed with encouraging results. An arrangement with redundant Brayton power systems having a 1500 K (2240 F) turbine inlet temperature was shown to be compatible with the dimensions of the space shuttle orbiter payload bay. B.W.

N82-24421* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LINEAR MAGNETIC MOTOR/GENERATOR Patent
P. A. STUDER, inventor (to NASA) 9 Feb. 1982 13 p Filed 7 Feb. 1980 Supersedes N80-19424 (18 - 10, p 1287)
(NASA-CASE-GSC-12518-1; US-PATENT-4,315,197; US-PATENT-APPL-SN-119336; US-PATENT-CLASS-318-135; US-PATENT-CLASS-335-229; US-PATENT-CLASS-335-266; US-PATENT-CLASS-310-12) Avail: US Patent and Trademark Office CSCL 09A

A linear magnetic motor/generator is disclosed which uses magnetic flux to provide mechanical motion or electrical energy. The linear magnetic motor/generator includes an axially movable actuator mechanism. A permanent magnet mechanism defines a first magnetic flux path which passes through a first end portion of the actuator mechanism. Another permanent magnet mechanism defines a second magnetic flux path which passes through a second end portion of the actuator mechanism. A drive coil defines a third magnetic flux path passing through a third central portion of the actuator mechanism. A drive coil selectively adds magnetic flux to and subtracts magnetic flux from magnetic flux flowing in the first and second magnetic flux path.
Official Gazette of the U.S. Patent and Trademark Office

N82-24424*# Department of Energy, Washington, D. C.
DEVELOPMENT OF A DUAL-FIELD HETEROPOPLAR POWER CONVERTER
D. B. EISENHAURE, B. JOHNSON, T. E. BLIAMPTIS, and E. STGEORGE Aug. 1981 68 p refs
(Contract NAS3-20817; DE-AI01-77CS-1044)
(NASA-CR-165168; NAS 1.26:165168; R-1489) Avail: NTIS HC A04/MF A01 CSCL 10B

The design and testing of a 400 watt, dual phase, dual rotor, field modulated inductor alternator is described. The system is designed for use as a flywheel to ac utility line or flywheel to dc bus (electric vehicle) power converter. The machine is unique in that it uses dual rotors and separately controlled fields to produce output current and voltage which are in phase with each other. Having the voltage and current in phase allows the power electronics to be made of simple low cost components. Based on analytical predictions and experimental results, development of a complete 22 kilowatt (30 Hp) power conversion system is recommended. This system would include power electronics and controls and would replace the inductor alternator with an improved electromagnetic conversion system. Author

N82-24425*# Eaton Engineering and Research Center, Southfield, Mich.
STRAIGHT AND CHOPPED DC PERFORMANCE DATA FOR A GENERAL ELECTRIC 5BY436A1 DC SHUNT MOTOR WITH A GENERAL ELECTRIC EV-1 CONTROLLER Final Report
P. C. EDIE Oct. 1981 58 p
(Contract DEN3-123; DE-AI01-77CS-51044)
(NASA-CR-165507; DOE/NASA/0123-4; NAS 1.26:165507; ERC-TR-8186) Avail: NTIS HC A04/MF A01 CSCL 09C

Both straight and chopped dc motor performance data for a General Electric 5BY436A1 motor with a General Electric EV-1 controller is presented in tabular and graphical formats. Effects of motor temperature and operating voltage are also shown. The maximum motor efficiency is approximately 85% at low operating temperatures in the straight dc mode. Chopper efficiency can be assumed to be 95% under all operating conditions. For equal speeds, the motor operated in the chopped mode develops slightly more torque and draws more current than it does in the straight mode. Author

N82-24461# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
EARTH-COUPLED HEAT PUMP Final Report, 1 Jul. 1979 - 30 Sep. 1980
J. A. EDWARDS 30 Aug. 1981 41 p refs
(DE82-900583; NCEI-0033) Avail: NTIS HC A03/MF A01

The object of the research work was to demonstrate that a water source heat pump could be used with an earth-coupled heat exchanger which was buried in an absorption field of a domestic sewage disposal system to provide the heating and cooling requirements for residential use in an energy efficient fashion. The system consists of a 3 ton heat pump (nominal rating of 34,000 Btu/hr), a closed-loop heat exchanger which was fabricated from 200 feet of 2 inch diameter cast iron soil pipe, and a calorimeter house which had heat transmission characteristics similar to a 100 sq ft house. The earth-coupled heat exchanger was connected to the water side heat exchanger of the heat pump. Water was circulated through the heat exchanger coil in the earth and through the water side heat exchanger of the heat pump. The earth served as the energy source (for heating) or sink (for cooling) for the heat pump. DOE

N82-24639* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AMPLIFIED WIND TURBINE APPARATUS Patent
L. A. HEIN and W. N. MYERS, inventors (to NASA) 5 Jan. 1982 8 p Filed 12 Mar. 1980 Supersedes N80-21831 (18 - 12, p 1597)
(NASA-CASE-MFS-23830-1; US-PATENT-4,309,146; US-PATENT-APPL-SN-129780; US-PATENT-CLASS-415-2R; US-PATENT-CLASS-415-DIG.8) Avail: US Patent and Trademark Office CSCL 10B

An invention related to the utilization of wind energy and increasing the effects thereof for power generation is described. Amplified wind turbine apparatus is disclosed wherein ambient inlet air is prerotated in a first air rotation chamber having a high pressure profile increasing the turbulence and Reynolds number thereof. A second rotation chamber adjacent and downstream of the turbine has a low pressure core profile whereby flow across the turbine is accelerated and thereafter exits the turbine apparatus through a draft anti-interference device. Interference with ambient winds at the outlet of the turbine apparatus is thus eliminated. Pivotable vanes controlled in response to prevailing wind direction admit air to the chambers and aid in imparting rotation. A central core may be utilied for creating the desired pressure profile in the chamber. M.D.K.

N82-24701# Brookhaven National Lab., Upton, N. Y.
IMPROVED ALKALINE HYDROGEN/AIR FUEL CELLS FOR TRANSPORTATION APPLICATIONS
S. SRINIVASAN, J. MCBREEN, G. KISSEL, K. V. KORDESCH, F. KULESA, E. J. TAYLOR, and E. GANNON *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 188-192 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

The improvement of alkaline air electrodes for air depolarized chlor/alkali cells is discussed. Some of these electrodes were evaluated in alkaline hydrogen/air fuel cells. In initial tests with 289 sq cm electrodes, power densities of 100 mW/sq cm were obtained at 0.65 V. Further improvements in the air electrode flow field yielded power densities of 126 mW/sq cm at 0.65 V at an operating temperature of 70 C. The 289 sq cm cells were units in a 16 cell 0.5 kW module. This module yielded similar power densities and its power/weight and power/volume are considered as a building block for a fuel cell power plant in a fuel cell/battery hybrid vehicle. E.A.K.

N82-24707# New York State Energy Research and Development Authority, Albany.
HYDROPOWERED ELECTROLYSIS IN NEW YORK STATE
P. D. MALTHUSA and R. A. WILEY *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 214-217 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

An inventory of New York State's hydropower potential located more than 1,000 sites with dams in the state which could be refurbished for power production. It is estimated that these facilities can be made to generate 3.8 billion kilowatt hours of (firm) electrical power per annum. It is found that the use of excess power to operate an advanced technology solid polymer electrolyzer produces research grade hydrogen whose kilowatt hour equivalent value is more than 10 times greater than that of dumped electrical energy. E.A.K.

N82-24981# Stanford Univ., Calif. Dept. of Mechanical Engineering.
AXIAL FIELD LIMITATIONS IN MHD GENERATORS. PART 2: ANALYTICAL INVESTIGATION AND COMPARISON WITH EXPERIMENTS
W. UNKEL and C. H. KRUGER Jan. 1981 32 p refs Backup document for AIAA Synoptic. 'Analytical Investigation of Axial Field Limitations in MHD Generators', scheduled for publication in Journal of Energy in Jan. - Feb. 1983
(LOG-E763) Avail: NTIS HC A03/MF A01

A detailed fluid and electrical model was developed and used to predict the prebreakdown and incipient breakdown characteristics for a simplified configuration. The model shows that an electro-thermal instability, in either the plasma or the interelectrode insulator, was responsible for the breakdown; the predicted values of the threshold voltage, below which breakdown would not occur, were comparable to the experimental values. Detailed comparison of theory and experiment, however, indicates only moderately good agreement, even for the relatively sophisticated model used. Nevertheless, the model can be used to predict the trends of threshold voltage with the channel parameters. Breakdown modeling of the full generator configuration was limited to a coarse electrical solution to simulate the effect of single or multiple breakdowns on the behavior of the surrounding gaps; moderate success was achieved with the model. Author

N82-25636*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPACT OF UNIFORM ELECTRODE CURRENT DISTRIBUTION ON ETF
D. J. BENTS 1982 10 p refs Presented at the 20th Aerospace Sci. Meeting, Orlando, Fla., 11-14 Jan 1982
(Contract DE-AI01-77ET-10769)
(NASA-TM-82875; E-1044; NAS 1.15:82875; DOE/NASA/10769-24) Avail: NTIS HC A02/MF A01 CSCL 10A

The design impacts on the ETF electrode consolidation network associated with uniform channel electrode current distribution are examined and the alternate consolidation design which occur are presented compared to the baseline (non-uniform current) design with respect to performance, and hardware requirements. A rational basis is given for comparing the requirements for the different designs and the savings that result from uniform current distribution. Performance and cost impacts upon the combined cycle plant are discussed. Author

N82-25961*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESULTS AND COMPARISON OF HALL AND DW DUCT EXPERIMENTS
J. M. SMITH and J. L. MORGAN 1982 10 p refs Proposed for presentation at the 20th Symp. on Eng. Aspects of Magnetohydrodyn., Los Angeles, 14-16 Jun. 1982
(Contract DE-AI01-77ET-10769)
(NASA-TM-82864; DOE/NASA/10769-25; E-1233; NAS 1.15:82864) Avail: NTIS HC A02/MF A01 CSCL 20I

Experimental data from recent tests of a 45 deg diagonal wall duct are presented and compared with the results of a similar Hall duct. It is shown that while the peak power density of the two devices is approximately equal that the diagonal wall duct produces greater total power output due to its ability to better utilize the available magnetic field. Author

N82-25981# Los Alamos Scientific Lab., N. Mex.
MODULAR STELLARATOR FUSION REACTOR CONCEPT
R. L. MILLER and R. A. KRAKOWSKI Aug. 1981 161 p refs
(Contract W-7405-ENG-36)
(DE82-001883; LA-8978-MS) Avail: NTIS HC A08/MF A01

A steady-state ignited, DT-fueled, magnetic fusion reactor is proposed for use as a central electric-power station. The MSR concept combines the physics of the classic stellarator confinement topology with an innovative, modular-coil design. Parametric tradeoff calculations are described, leading to the selection of an

interim design point for a 4-GWt plant based on Alcator transport scaling and an average beta value of 0.04 in an 1 = 2 system with a plasma aspect ratio of 11. The physical basis of the design point is described together with supporting magnetics, coil-force, and stress computations. T.M.

N82-25984# Los Alamos Scientific Lab., N. Mex.
ELMO BUMPY TORUS REACTOR AND POWER PLANT: CONCEPTUAL DESIGN STUDY
C. G. BATHKE, D. J. DUDZIAK, R. A. KRAKOWSKI, W. B. ARD, D. A. BOWERS, J. W. DAVIS, D. A. DEFREECE, D. E. DRIEMEYER, R. E. JUHALA, R. J. KASHUBA et al. Aug. 1981 902 p refs Prepared in cooperation with McDonnell Douglas Astronautics Co., St. Louis, Parsons (Ralph M.) Co., Pasadena, Calif., General Dynamics Convair, San Diego, Calif., and JAYCOR, San Diego, Calif.
(Contract W-7405-ENG-36)
(DE82-002437; LA-8882-MS) Avail: NTIS HC A99/MF A01

A complete power plant design of a 1200-MWe ELMO Bumpy Torus Rector (EBTR) is presented. An emphasis is placed on those features that are unique to the EBT confinement concept, with subsystems and balance-of-plant items that are more generic to magnetic fusion being adapted from past, more extensive Tokamak reactor designs. Similar to the latter Tokamak studies, this conceptual EBTR design also emphasizes the use of conventional or near state-of-the-art engineering technology and materials. An emphasis is also placed on system accessibility, reliability, and maintainability, as these crucial and desirable characteristics relate to the unique high-aspect-ratio configuration of EBTs. Equal and strong emphasis is given to physics, engineering/technology, and costing/economics components of this design effort. Parametric optimizations and sensitivity studies, using cost-of-electricity as an object function, are reported. Based on these results, the direction for future improvement on an already attractive reactor design is identified. DOE

N82-26678*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTIROLLER TRACTION DRIVE SPEED REDUCER: EVALUATION FOR AUTOMOTIVE GAS TURBINE ENGINE
D. A. ROHN, N. E. ANDERSON, and S. H. LOEWENTHAL Jun. 1982 24 p refs Prepared in cooperation with Army Aviation Research and Development Command, Cleveland, Ohio
(NASA-TP-2027; E-1002; NAS 1.60:2027;
AVRADCOM-TR-81-C-11) Avail: NTIS HC A02/MF A01 CSCL 20A

Tests were conducted on a nominal 14:1 fixed-ratio Nasvytis multiroller traction drive retrofitted as the speed reducer in an automotive gas turbine engine. Power turbine speeds of 45,000 rpm and a drive output power of 102 kW (137 hp) were reached. The drive operated under both variable roller loading (proportional to torque) and fixed roller loading (automatic loading mechanism locked). The drive operated smoothly and efficiently as the engine speed reducer. Engine specific fuel consumption with the traction speed reducer was comparable to that with the original helical gearset. Author

N82-26694# Ingersoll-Rand Research, Inc., Princeton, N. J.
FEASIBILITY OF USING LARGE VERTICAL PUMPS AS TURBINES FOR SMALL SCALE HYDROPOWER Final Technical Report
P. COOPER and R. WORTHEN 1981 229 p refs
(Contract DE-AC07-8010-12160)
(DE82-004267; DOE/ID-12160/T1) Avail: NTIS HC A11/MF A01

The economic and technical feasibility of operating pumps as turbines in small scale hydropower plants was established. The economics were competitive, and turbine efficiencies of 87% were obtained in actual tests. DOE

N82-26790*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMIZATION OF THE OXIDANT SUPPLY SYSTEM FOR COMBINED CYCLE MHD POWER PLANTS
A. J. JUHASZ 1982 14 p refs Presented a the 20th Symp. on the Eng. Aspects of Magnetohydrodyn., Irvine, Calif., 14-16 Jun. 1981
(Contract DE-AI01-77ET-10769)
(NASA-TM-82909; E-1294; DOE/NASA/10769-27; NAS 1.15:82909) Avail: NTIS HC A02/MF A01

An in-depth study was conducted to determine what, if any, improvements could be made on the oxidant supply system for combined cycle MHD power plants which could be reflected in higher thermal efficiency and a reduction in the cost of electricity, COE. A systematic analysis of air separation process varitions which showed that the specific energy consumption could be minimized when the product stream oxygen concentration is about 70 mole percent was conducted. The use of advanced air compressors, having variable speed and guide vane position control, results in additional power savings. The study also led to the conceptual design of a new air separation process, sized for a 500 MW sub e MHD plant, referred to a internal compression is discussed. In addition to its lower overall energy consumption, potential capital cost savings were identified for air separation plants using this process when constructed in a single large air separation train rather than multiple parallel trains, typical of conventional practice. B.W.

N82-26807*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MOD-2 WIND TURBINE SYSTEM CLUSTER RESEARCH TEST PROGRAM. VOLUME 1: INITIAL PLAN E-1290 Final Report
L. H. GORDON Mar. 1982 92 p refs 2 Vol.
(NASA-TM-82906; NAS 1.15:82906; DOE/NASA/20305-8) Avail: NTIS HC A05/MF A01 CSCL 10A

Upon completion of the design and development of three Mod-2 wind turbines, a series of research experiments are planned to gather data on and evaluate the performance, environmental effects, and operation of a cluster as well as a single, large multimegawatt wind turbine. Information on the program objectives, a Mod-2 system description, a planned schedule, organizational roles, and responsibilities, is included. T.M.

N82-26823# Sandia Labs., Albuquerque, N. Mex.
DYNAMIC ANALYSIS OF DARRIEUS VERTICAL AXIS WIND TURBINE ROTORS
D. W. LOBITZ May 1981 26 p refs
(Contract DE-AC04-76DP-00789)
(DE82-000814; SAND-80-2820) Avail: NTIS HC A03/MF A01

The dynamic response characteristics of the VAWT rotor are important factors governing the safety and fatigue life of VAWT systems. The principal problems are the determination of critical rotor speeds (resonances) and the assessment of forced vibration response amplitudes. The solution to these problems is complicated by centrifugal and Coriolis effects which can have substantial influence on rotor resonant frequencies and mode shapes. The primary tools now in use for rotor analysis are described. These tools include a lumped spring mass model (VAWTDYN) and also finite element based approaches. The discussion centers on the accuracy and completeness of current capabilities and plans for future research. T.M.

N82-26828# Sandia Labs., Albuquerque, N. Mex.
USER'S MANUAL FOR THE VERTICAL AXIS WING TURBINE CODE VDART2
J. H. STRICKLAND, T. SMITH, and K. SUN Sep. 1981 70 p refs
(Contract DE-AC04-76DP-00789)
(DE82-000796; SAND-81-7039) Avail: NTIS HC A04/MF A01

This user's manual provides details on the Darrieus wind turbine aerodynamic performance/loads prediction computer code, VDART2. The code is the latest generation of vortex-based models

and includes the effects of dynamic stall, pitching circulation, and added mass. DOE

N82-26832# JBF Scientific Corp., Wilmington, Mass.
METHODOLOGY FOR DETERMINING THE VALUE OF WIND ENERGY CONVERSION SYSTEMS FOR SPECIFIC UTILITY SYSTEMS
Sep. 1981 35 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-002679; SERI/TR-98336-2) Avail: NTIS HC A03/MF A01

The methodology uses to the maximum extent possible techniques that the electric utility industry developed to determine the relative economic attractiveness of alternative generation expansion plans. Three factors are emphasized in the methodology: the site dependence of wind resources, the inability to control the electrical output of wind energy conversion systems, and the lack of reliable WECS cost information. T.M.

N82-26841# Rockwell International Corp., Golden, Colo. Energy Systems Group.
SMALL WIND SYSTEMS APPLICATION ANALYSIS. EXECUTIVE SUMMARY
Jun. 1981 32 p Prepared in cooperation with JBF Scientific Corp., Washington
(Contract DE-AC04-76DP-03533)
(DE82-004206; RFP-3147/1) Avail: NTIS HC A03/MF A01

The potential market for SWECS, or wind machines smaller than 100 kW for five selected applications was estimated. The goals of the study were to aid manufacturers in attaining financing by convincing venture capital investors of the potential of SWECS and to aid government planners in allocating R and D expenditures that will effectively advance SWECS commercialization. The five applications were selected through an initial screening and priority-ranking analysis. The year of analysis was 1985, but all dollar amounts, such as fuel costs, are expressed in 1980 dollars. The five SWECS applications investigated were farm residences, non-farm residences rural electric cooperatives, feed grinders, and remote communities. T.M.

N82-26844# Argonne National Lab., Ill. Engineering Applications Section.
COMPARISON OF RANKINE-CYCLE POWER SYSTEMS: EFFECTS OF SEVEN WORKING FLUIDS
T. J. MARCINIAK, J. L. KRAZINSKI (Purdue Univ., Hammond, Ind.), J. C. BRATIS, H. M. BUSHBY, and E. H. BUYCO Jun. 1981 88 p refs
(Contract W-31-109-ENG-38)
(DE82-005599; ANL/CNSV-TM-87) Avail: NTIS HC A05/MF A01

The safety, technical and economic issues surrounding the prime working-fluid candidates for industrial Rankine-cycle power systems in the range of 600 to 2400 kW are investigated. These fluids are water, methanol, 2-methyl pyridine/H2O, Fluorinol 85, toluene, Freon R 11, and Freon R 113. At temperatures below about 7000F (3710C), steam systems become less efficient and too expensive to be used. However, other working fluids, usually organic compounds, can be economically attractive at the lower temperatures. This study shows that, at current and projected energy costs, Rankine-cycle power systems using any of the seven working fluids investigated here can exceed the minimum return on investment (ROI) criteria of most industries. The highest ROIs occur for those systems using a 3000F (1490C) condensing stream as the heat source. There appear to be no significant health or safety problems that would prevent the use of any of the candidate working fluids. The only limitation of an organic fluid is its maximum stability temperature, which may prevent its use with high-temperature waste-heat streams. DOE

N82-26853# Tennessee Univ. Space Inst., Tullahoma. Space Inst.
MHD COAL-FIRED FLOW FACILITY Annual Technical Progress Report, Oct. 1979 - Sep. 1980
M. C. ALSTATT, R. C. ATTIG, D. A. BROSNAN, J. N. CHAPNAN, R. W. CLEMONS, T. A. CLICK, J. A. COOPER, L. W. CRAWFORD, J. B. DICKS, and T. E. DWODY Mar. 1981 27 p refs
(Contract DE-AC01-76ET-10757; DE-AC02-79ET-10815)
(DE82-003814; DOE/ET-10815/59) Avail: NTIS HC A03/MF A01

Significant activity, task status, planned research, testing, development, and conclusions for the magnetohydrodynamics (MHD) coal fired flow facility (CFFF) and the energy conversion facility (ECF) is reported. The following tasks are considered: (1) compilation of design and construction of the CFFF and activation; (2) design and fabrication of the 8PPS test equipment; (3) phase operations for the CFFF and EC facility; (4) 8PPS high slag throughput testing; (5) testing of DOE supplied components; (6) modifications of the CFFF; and (7) technology development program. DOE

N82-27081# Artec Associates, Inc., Hayward, Calif.
MHD PHENOMENA AT HIGH MAGNETIC REYNOLDS NUMBER Final Report
S. P. GILL and D. MUKHERJEE Dec. 1981 104 p refs
(Contract N00014-79-C-0565; NR PROJ. 099-429)
(AD-A110929; FR-137) Avail: NTIS HC A06/MF A01 CSCL 20C

Exact MHD solutions have been derived for the propagation of a shock-ionized plasma through applied magnetic field configurations pertinent to two- and three-dimensional MHD generators and plasma diagnostics. Calculated magnetic field perturbations and Faraday voltages are presented for a wide range of magnetic Reynolds number. The solutions provide insight into eddy current and magnetic diffusion effects in MHD generator sections. Author (GRA)

N82-27141# Naval Weapons Center, China Lake, Calif. Physics Div.
EXPLOSION DRIVEN MAGNETOGASDYNAMIC FLOWS WITH HIGH MAGNETIC REYNOLDS AND INTERACTION NUMBERS Annual Report, 1 Feb. - 30 Sep. 1981
H. E. WILHELM 1 Dec. 1981 120 p refs
(Contract N00014-81-WR-10107)
(AD-A112049) Avail: NTIS HC A06/MF A01 CSCL 20C

Detonation driven magnetogasdynamic generators with external R-L load circuits are analyzed, for which the external and induced magnetic fields are parallel and antiparallel, respectively. Two plasma shock flow models are treated: (1) implosion produced jet flow and (2) plane detonation flow. A theory of power generation is developed for a stress polarizable solid between plane electrodes (with an external ohmic load circuit), which is electrically polarized by an explosion produced stress shock wave. In connection with the analysis of flux compression power generators, initial-boundary-value problems for the diffusion of magnetic fields into conductors with external electromagnetic transients and the electromagnetic induction in conductors accelerated in external magnetic fields are solved. A quantum-kinetic theory of the anomalous electron heating in plasmas by high-frequency electromagnetic fields is presented. Author (GRA)

N82-27142# ARO, Inc., Arnold Air Force Station, Tenn.
HIGH POWER MHD SYSTEM: FACILITY STATUS AND MAGNET TEST RESULTS Final Report, 1 Jul. 1977 - 30 Sep. 1980
G. L. WHITEHEAD AEDC Feb. 1982 107 p refs
(AD-A112102; AEDC-TR-81-14) Avail: NTIS HC A06/MF A01 CSCL 20C

AEDC has been requested by the Aero Propulsion Laboratory to design, fabricate, and install facility hardware necessary to conduct tests to demonstrate the performance of high power MHD generator systems developed by AFWAL contractors. This report summarizes the AEDC effort since program inception, describes the facility under development, gives the status of each major

facility component, and summarizes the results of the data acquired during magnet checkout tests. The report also describes the future effort required to make the facility a useful tool for MHD generator system and component development. Author (GRA)

N82-27151# California Univ., Livermore. Lawrence Livermore Lab.
DESIGN SCOPING STUDY OF THE 12T YIN-YANG MAGNET SYSTEM FOR THE TANDEM MIRROR NEXT STEP (TMNS) Final Report
Sep. 1981 308 p refs Prepared in cooperation with General Dynamics/Convair, San Diego
(Contract W-7405-ENG-48)
(DE82-003218; UCRL-15405) Avail: NTIS HC A14/MF A01

The feasibility of designing a Yin-Yang magnet capable of producing a peak field in the windings of 12T for the Tandem Mirror Next Step (TMNS) program was determined. A rough order of magnitude (ROM) cost estimate of the winding for this magnet was undertaken. The preferred approach to the winding design of the TMNS plug coil utilizes design concepts to meet the structural, electrical and thermodynamic requirements of the magnet system. Structurally, the coil is radially partitioned into four sections, preventing the accumulation of the radial loads and reacting them into the structural case. To safely dissipate the 13.34 GJ of energy stored in each Yin-Yang magnet, the winding is electrically subdivided into parallel or nested coils, each with its own power supply and protection circuitry. The arrangement divides the total stored energy of the coils into manageable subsystems. The windings are cooled with superfluid helium 2, operated at 1.8K and 1.2 atmospheres. DOE

N82-27155# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
MHD GENERATOR ELECTRODE DEVELOPMENT Quarterly Report, Apr. - Jun. 1981
F. D. RETALLICK, D. L. DIETRICK, I. LLOYD, B. R. ROSSING, and R. SMITH Aug. 1981 65 p refs
(Contract DE-AC01-79ET-15529)
(DE82-002561; DOE/ET-15529/11) Avail: NTIS HC A04/MF A01

Metallurgical and engineering understanding of cold metallic electrode alternatives to the continued use of platinum as an anode clad material is discussed. The results of evaluating materials for MHD electrodes through use of a laboratory electrochemical and arc test are presented. Results for standard available materials as well as for some specially fabricated ones are presented. The development of a high temperature (11000 C to 14000 C) electrochemical test is outlined. Initial operation of the Westinghouse Electrode Systems Test Facility (WESTF), since major modification to include a magnet, is reported for a test section designed to operate as a small scale MHD generator and for test sections designed for the purpose of materials test evaluation in the operating MHD plasma environment. DOE

N82-27172# Riso National Lab., Roskilde (Denmark). Metallurgy Dept.
INTRODUCTION TO PROTON CONDUCTION IN SOLIDS
F. W. POULSEN Sep. 1980 23 p refs
(RISO-M-2244) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries Also available from Issuing Activity

Fuel cell and other possible applications of solid proton conductors are described. The best performing materials known today are listed. Typical synthetic routes and some models for proton transport in solids are discussed. Hints to future research are given. The literature collected for this report covers mainly the period 1974-1980. DOE

N82-27193# R and D Associates, Marina Del Rey, Calif.
CONCEPT EVALUATION OF AUTOMOTIVE PROPULSION USING LIQUID AIR/NITROGEN. TASK 1 REPORT. THERMODYNAMICS.
J. L. DOOLEY and R. P. HAMMOND Oct. 1981 56 p refs
(Contract DE-AC01-81ER-30011)
(DE82-002460; RDA-TR-118700-001) Avail: NTIS HC A04/MF A01

An automotive powerplant system using cryogenic liquid air or nitrogen as the working fluid in a powerplant operating on an open Rankine type cycle was assessed. The cold fluid is pressurized, heat energy is added to form hot gas and is expanded to atmospheric conditions in the engine which drive the vehicle. A range of gas pressures and temperatures as well as different expansion stages and reheat configurations are evaluated. The thermodynamic results indicate that this powerplant concept can be competitive with a comparable gasoline engine to give a vehicle equal in performance, weight, range and operating cost without using imported fuel. DOE

N82-27837*# Gilbert/Commonwealth, Reading, Pa.
MAGNETOHYDRODYNAMICS (MHD) ENGINEERING TEST FACILITY (ETF) 200 MWE POWER PLANT. CONCEPTUAL DESIGN ENGINEERING REPORT (CDER). VOLUME 2: ENGINEERING. VOLUME 3: COSTS AND SCHEDULES Final Report
Sep. 1981 163 p Volume 3 is included as MF 5 Vol.
(Contract DEN3-224; DE-AI01-77ET-10769)
(NASA-CR-165452-VOL-2; NASA-CR-165452-VOL-3; NAS 1.26:165452-VOL-2; NAS 1.26:165452-VOL-3; DOE/NASA/0224-1) Avail: NTIS HC E08/MF A01 CSCL 10B

Engineering design details for the principal systems, system operating modes, site facilities, and structures of an engineering test facility (ETF) of a 200 MWE power plant are presented. The ETF resembles a coal-fired steam power plant in many ways. It is analogous to a conventional plant which has had the coal combustor replaced with the MHD power train. Most of the ETF components are conventional. They can, however, be sized or configured differently or perform additional functions from those in a conventional coal power plant. The boiler not only generates steam, but also performs the functions of heating the MHD oxidant, recovering seed, and controlling emissions. S.L.

N82-27838*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARATIVE ANALYSIS OF THE CONCEPTUAL DESIGN STUDIES OF POTENTIAL EARLY COMMERCIAL MHD POWER PLANTS (CSPEC)
R. J. SOVIE, J. M. WINTER, A. J. JUHASZ, and R. D. BERG (Gilbert Associates, Inc.) 1982 27 p refs Presented at the 20th Symp. on the Eng. Aspects of Magnetohydrodyn., Irvine, Calif., 14-16 Jun. 1982
(Contract DE-AI01-77ET-10769)
(NASA-TM-82897; DOE/NASA/10769-26; NAS 1.15:82897)
Avail: NTIS HC A03/MF A01 CSCL 10B

A conceptual design study of the MHD/steam plant that incorporates the use of oxygen enriched air preheated in a metallic heat exchanger as the combustor oxidant showed that this plant is the most attractive for early commercial applications. The variation of performance and cost was investigated as a function of plant size. The contractors' results for the overall efficiencies are in reasonable agreement considering the slight differences in their plant designs. NASA LeRC is reviewing cost and performance results for consistency with those of previous studies, including studies of conventional steam plants. LeRC in house efforts show that there are still many tradeoffs to be considered for these oxygen enriched plants and considerable variations can be made in channel length and level of oxygen enrichment with little change in overall plant efficiency. A.R.H.

N82-27846# Thermo Electron Corp., Waltham, Mass.
ADVANCED THERMIONIC TECHNOLOGY PROGRAM Progress Report, Apr. - Jun. 1981
1981 32 p refs
(Contract DE-AC02-76ET-11292)
(DE82-002116; TE-4258-25-82; PR-47; COO-3056-47) Avail: NTIS HC A03/MF A01

Improvement of thermionic performance to the level that thermionic topping of fossil fuel powerplants becomes technically possible and economically attractive was investigated. The operation of a thermionic module in a power plant during the mid 1980's and to demonstrate reliable thermionic operation in a combustion environment were studied. Reported accomplishments include: (1) continuing stable output from the combustion test of the one inch diameter hemispherical silicon carbide diode (Converter No. 239) at an emitter temperature of 1730 K for a period of over 8500 hours; (2) determination of the elemental composition (i.e., molybdenum, nickel and cesium) through the sublimed molybdenum collector of Converter No. 262; and (3) demonstration of tungsten CVD onto molybdenum flange using a reuseable graphite mandrel. DOE

N82-27848# Case Western Reserve Univ., Cleveland, Ohio.
OXYGEN ELECTRODES FOR ENERGY CONVERSION AND STORAGE Annual Report, 1 Oct. 1979 - 30 Sep. 1980
5 Nov. 1981 284 p refs
(Contract DE-AC02-77ET-25502)
(DE82-005305; DOE/ET-25502/3) Avail: NTIS HC A13/MF A01

The main theme of this project has been to develop high performance oxygen electrodes for a spectrum of applications including industrial electrolysis, metal-air batteries and fuel cells. The research at CWRU emphasizes the development of more effective electrocatalysts for both O2 reduction and electrogeneration and also more effective electrode structures (particularly for O2 cathodes) for utilizing these catalysts. The approach used by the CWRU group involves the development of a predictive base to guide the search for the new catalysts systems. The DSC group is concerned principally with the evaluations of catalysts developed and recommended by CWRU as well as by their own staff and the fabrication of electrode structures for these evaluations. Progress is reported in detail. DOE

N82-27850# Kusko (Alexander), Inc., Needham Heights, Mass.
POWER SUPPLY SUBSYSTEM FOR MHD GENERATOR SUPERCONDUCTING MAGNET, BASELINE POWER SUPPLY DESIGNS AND COSTS
A. KUSKO and S. M. PEERAN 10 Apr. 1981 154 p refs
(Contract DE-AT01-76ET-10813)
(DE81-024285; DOE/ET-10813/T1) Avail: NTIS HC A08/MF A01

An analysis of the dc power supply requirements for superconducting magnets used in MHD generators of ratings 250 MW sub e to 1000 MW sub e is presented. The power supplis considered are rated for a peak power of 10 MW and for currents of 20 kA to 100 kA. The various aspects discussed include: rectifier configurations and specifications, control requirements, dumping the magnet energy, and rectifier size, arrangement and cost. (WHK) DOE

N82-27853# VSE Corp., Alexandria, Va.
OTEC SUPPORT SERVICES Quarterly Technical Progress Report, 15 Aug. - 14 Nov. 1981
Nov. 1981 15 p
(Contract DE-AC02-78ET-21002)
(DE82-005470; DOE/ET-21002/T20; QTPR-14) Avail: NTIS HC A02/MF A01

Progress in system integration, system engineering, and management services is reported. The effort is divided into seven tasks: survey, analysis, and evaluation of technical program status; program technical monitoring; development and implementation of methodology for identification, evaluation, and tradeoff for major subsystem configurations; technical assessments; OTEC system integration; environment and siting considerations; and transmission subsystem considerations. DOE

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ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission.

A82-31897#
OSMOTIC PUMPED HEAT PIPES FOR LARGE SPACE PLATFORMS
H. J. TANZER, G. L. FLEISCHMAN (Hughes Aircraft Co., Torrance, CA), and D. D. STALMACH (Vought Corp., Dallas, TX) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 11 p. refs
(AIAA PAPER 82-0902)

A thermal bus will be required as a thermal control source for future space platforms. The osmotic heat pipe is one candidate device with potential significant payoff toward serving growing thermal management needs. Results of a study evaluating osmotic heat pipes for thermal bus applications are presented. Electrostatic and other techniques are proposed for flow control and solution circulation in zero-gravity. Baseline size and performance design parameters of cellulose acetate membrane/sugar-water solution and other combinations were scaled up to predict osmotic pump performance for heat loads and temperatures of 4 to 120 C. A compact hollow-fiber membrane module measuring 20 inches in diameter by 12 inches long and weighing 190 pounds is projected for 50-kW heat loads. (Author)

A82-31898*# Hughes Aircraft Co., Torrance, Calif.
DESIGN, FABRICATION AND TEST OF LIQUID METAL HEAT-PIPE SANDWICH PANELS
A. BASIULIS (Hughes Aircraft Co., Torrance, CA) and C. J. CAMARDA (NASA, Langley Research Center, Hampton, VA) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 8 p. refs
(AIAA PAPER 82-0903)

Integral heat-pipe sandwich panels, which synergistically combine the thermal efficiency of heat pipes and the structural efficiency of honeycomb sandwich panel construction, were fabricated and tested. The designs utilize two different wickable honeycomb cores, facesheets with screen mesh sintered to the internal surfaces, and potassium or sodium as the working fluid. Panels were tested by radiant heating, and the results indicate successful heat pipe operation at temperatures of approximately 922 K (1200 F). These panels, in addition to solving potential thermal stress problems in an Airframe-Integrated Scramjet Engine, have potential applications as cold plates for electronic component cooling, as radiators for space platforms, and as low distortion, large area structures. (Author)

A82-32368*
METEOROLOGICAL EFFECTS ON LASER PROPAGATION FOR POWER TRANSMISSION
R. E. BEVERLY, III Space Solar Power Review, vol. 3, no. 1, 1982, p. 9-29. refs
(Contract NAS8-32475)

An examination of possible laser operating parameters for power transmission to earth from solar power satellites is presented, with particular attention paid to assuring optimal delivery at midlatitudes. The degradation of beam efficiency due to molecular scattering, molecular absorption, aerosol scattering, and aerosol

absorption during beam propagation through the atmosphere can be alleviated by judicious choice of wavelength windows, elevating the receptor sites, using a vertical propagation path, or by hole boring, i.e., vaporizing the aerosol particles in the beam path. Analyses are given for the beam propagation through fog, haze, clouds, and snow using various transitions. Only weapons-quality lasers are seen as being capable of boring through clouds and aerosols, employing a CW beam with superimposed pulses at high power densities. It is concluded that further short wavelength transmission experiments be performed to demonstrate transmission feasibility with the CW/pulsed mode of beam propagation. M.S.K.

A82-32369*
POWER AVAILABILITY AT TERRESTRIAL RECEPTOR SITES FOR LASER-POWER TRANSMISSION FROM THE SATELLITE POWER SYSTEM
R. E. BEVERLY, III Space Solar Power Review, vol. 3, no. 1, 1982, p. 31-44. refs
(Contract NAS8-32475)

A statistical model was developed for relating the temporal transmission parameters of a laser beam from a solar power satellite to observable meteorological data to determine the influence of weather on power reception at the earth-based receiver. Sites within 100 miles of existing high voltage transmission lines were examined and the model was developed for clear-sky and clouded conditions. The cases of total transmission through clouds at certain wavelengths, no transmission, and partial transmission were calculated for the cloud portion of the model. The study covered cirriform, stratiform, cumiliform, and mixed type clouds and the possibility of boring holes through the clouds with the beam. Utilization of weapons-quality beams for hole boring, was found to yield power availability increases of 9-33%, although no beneficial effects could be predicted in regions of persistent cloud cover. An efficiency of 80% was determined as possible if several receptor sites were available within 200-300 miles of each other, thereby allowing changes of reception point in cases of unacceptable meteorological conditions. M.S.K.

A82-32370
LASER SATELLITE POWER SYSTEMS - CONCEPTS AND ISSUES
E. W. WALBRIDGE (Argonne National Laboratory, Argonne, IL) Space Solar Power Review, vol. 3, no. 1, 1982, p. 45-71. Research supported by the U.S. Department of Energy. refs

A laser satellite power system (SPS) converts solar power captured by Earth-orbiting satellites into electrical power on the Earth's surface, the satellite-to-ground transmission of power being effected by a laser beam. The laser SPS is an alternative to the microwave SPS. Lasers and how they work are described, as are the types of lasers - electric discharge, direct and indirect solar pumped, free electron, and closed-cycle chemical - that are candidates for application in a laser SPS. The advantages of a laser SPS over the microwave alternative are pointed out. One such advantage is that, for the same power delivered to the utility busbar, land requirements for a laser system are much smaller (by a factor of 21) than those for a microwave system. The four laser SPS concepts that have been presented in the literature are described and commented on. Finally key issues for further laser SPS research are discussed. (Author)

A82-33447
SIMULATION OF D AND E REGION HIGH-POWER MICROWAVE HEATING WITH HF IONOSPHERIC MODIFICATION EXPERIMENTS
G. MELTZ (United Technologies Research Center, East Hartford, CT), C. M. RUSH, and E. J. VIOLETTE (National Telecommunications and Information Administration, Institute for Telecommunication Sciences, Boulder, CO) Radio Science, vol. 17, May-June 1982, p. 701-715. refs

The satellite power system is to utilize a microwave beam for the transmission of electric power to earth. It is, therefore, important to investigate the possible effects of such beams on the operation of telecommunication systems. In 1979 and 1980 a series of heating experiments were conducted using the high-power HF transmitter facility at Platteville, Colorado, to investigate the effects of ionospheric heating on the performance of certain telecommunications systems. The present investigation has the objective to compare the results of ionospheric changes obtained during these experiments with the theoretical estimates of the expected electron temperature and density changes. The described results were obtained by heating the ionosphere with 5.2- and 9.9-MHz high-powered signals and using a pulse ionosonde probe to detect the changes in the D and lower E regions. G.R.

N82-22444# Westinghouse Research and Development Center, Pittsburgh, Pa.
MATERIALS RESEARCH FOR HYDROGEN-COOLED SUPERCONDUCTING POWER TRANSMISSION LINES Quarterly Report, 1 Jan. - 31 Mar. 1981
A. M. SLETTEN, A. I. BRAGINSKI, M. ROSADO, and J. R. GAVALER 1981 18 p refs
(Contract DE-AC04-79ET-29354)
(DE82-002170; DOE/ET-29354/T2; QR-5) Avail: NTIS HC A02/MF A01

Dielectric breakdown and loss measurements in liquid hydrogen and liquid hydrogen impregnated synthetic dielectrics, at temperatures between 14 and 200K and at hydrostatic pressures up to 5 atmospheres are performed. Effects of dissolved impurities/additives in the liquid are included. The self field and low field superconducting properties of high critical temperature materials are characterized at temperatures between approximately 14 and 200K. The experiments on dielectrics were conducted outdoors, due to safety considerations. The Design of the auxiliary equipment for the tests on the dielectric properties of LH2 was finished, and all the key components were ordered. A safety analysis report was started to discuss the effect of the setting on the safety aspects of this project; the design of the system of small electrodes was modified to provide individual ground connections for each ground electrode; data on Tc vs. composition was obtained for several samples of carbon doped V3Si; and the Nb3 Ge chemical vapor deposition apparatus was reactivated. DOE

N82-22722*# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
SOLAR DRIVEN LASERS FOR POWER SATELLITE APPLICATIONS
R. TAUSSIO, P. CASSADY, and E. KLOSTERMAN *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 267-270 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

The technological feasibility of using multimagawatt lasers for space power transmission is discussed. Candidate lasers include electric discharge lasers, direct optically pumped lasers, and free electron lasers. J.D.

N82-22723*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
POWER TRANSMISSION AND RECEPTION. AN OVERVIEW AND PERSPECTIVE
R. H. DIETZ *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 273-276 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Systems definition and assessment of the microwave power transmission and reception (PTAR) system for the solar power satellite are surveyed. Five different options are discussed and the separate antenna concept using the linear beam klystron to convert from dc to RF energy is described in detail. J.D.

N82-22724*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MICROWAVE SYSTEM PERFORMANCE SUMMARY
G. D. ARNDT and E. J. NALOS (Boeing Co., Seattle) *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 277-280 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

The design of the microwave system for the solar power satellite is described. Design modifications recommended include changes in phase control to the power module level, a reduction in allowable amplitude jitter, the use of metal matrix waveguides, and sequences for startup/shutdown procedures. Investigations into reshaping the beam pattern to improve overall rectenna collection efficiency and improve sidelobe control are surveyed.

N82-22736*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RECTENNA SYSTEM DESIGN
W. C. BROWN (Raytheon Co., Waltham, Mass.), R. M. DICKINSON, E. J. NALOS (Boeing Aerospace Co.), and J. H. OTT (Nova Electronics Corp.) *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 328-331 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

The function of the rectenna in the solar power satellite system is described and the basic design choices based on the desired microwave field concentration and ground clearance requirements are given. One important area of concern, from the EMI point of view, harmonic reradiation and scattering from the rectenna is also designed. An optimization of a rectenna system design to minimize costs was performed. The rectenna cost breakdown for a 56 w installation is given as an example. M.D.K.

N82-22739*# Rockwell International Corp., Anaheim, Calif.
SOLID-STATE CONFIGURATIONS
K. G. SCHROEDER *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 340-343 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Two prototype solid-state phased array systems concepts developed for the solar power satellite (SPS) are described. In both concepts, the beam was centered on the rectenna by means of phase conjugation of a pilot signal emanating from the ground. Also discussed are results of solid state studies. M.D.K.

N82-22741*# Rice Univ., Houston, Tex.
OFFSHORE RECTENNA FEASBILITY
J. W. FREEMAN, D. HERVEY (Brown and Root Development, Inc.), and P. GLASER (Arthur D. Little, Inc.) *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 348-351 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

A preliminary study of the feasibility and cost of an offshore rectenna to serve the upper metropolitan east coast was performed. A candidate site at which to build a 5 GW rectenna was selected on the basis of proximity to load centers, avoidance of shipping lanes, sea floor terrain, and relocated conditions. Several types of support structures were selected for study based initially on the reference system rectenna concept of a wire mesh ground screen and dipoles each with its own rectifier and filter circuits. Possible secondary uses of an offshore rectenna were examined and are evaluated. M.D.K.

N82-22742*# Massachusetts Inst. of Tech., Cambridge. Space Systems Lab.
HIGH-POWER MICROWAVE OPTICS FOR FLEXIBLE POWER TRANSMISSION SYSTEMS
K. E. DREXLER and B. R. SPERBER (Boeing Aerospace Co.) *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 352-355 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

A large concave microwave mirror near the transmitter can magnify the apparent size of the Earth as seen from a phased array, and vice versa, permitting a small phased array to be coupled to a small rectenna while preserving the transmission efficiency (the reflection loss is slight) and peak power densities characteristic of the reference system. This augmentation of the phased array aperture with a large mirror gives the system greater resolution (in the optical sense), and opens new degrees of freedom in SPS design. The consequences of such an approach for a prototype satellite were explored. Its consequences for a mature SPS are discussed. N.W.

N82-22743*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTRIC POWER PROCESSING, DISTRIBUTION, MANAGEMENT AND ENERGY STORAGE
R. J. GIUDICI *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 359-363 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

Power distribution subsystems are required for three elements of the SPS program: (1) orbiting satellite, (2) ground rectenna, and (3) Electric Orbiting Transfer Vehicle (EOTV). Power distribution subsystems receive electrical power from the energy conversion subsystem and provide the power busses rotary power transfer devices, switchgear, power processing, energy storage, and power management required to deliver control, high voltage plasma interactions, electric thruster interactions, and spacecraft charging of the SPS and the EOTV are also included as part of the power distribution subsystem design. N.W.

N82-22744*# Rockwell International Corp., Downey, Calif.
HIGH VOLTAGE SYSTEMS (TUBE-TYPE MICROWAVE)/LOW VOLTAGE SYSTEM (SOLID-STATE MICROWAVE) POWER DISTRIBUTION
A. A. NUSSBERGER and G. R. WOODCOCK (Boeing Aerospace Co., Seattle) *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 364-367 Jul. 1980
Avail: NTIS HC A99/MF A01 CSCL 10A

SPS satellite power distribution systems are described. The reference Satellite Power System (SPS) concept utilizes high-voltage klystrons to convert the onboard satellite power from dc to RF for transmission to the ground receiving station. The solar array generates this required high voltage and the power is delivered to the klystrons through a power distribution subsystem. An array switching of solar cell submodules is used to maintain bus voltage regulation. Individual klystron dc voltage conversion is performed by centralized converters. The on-board data processing system performs the necessary switching of submodules to maintain voltage regulation. Electrical power output from the solar panels is fed via switch gears into feeder buses and then into main distribution buses to the antenna. Power also is distributed to batteries so that critical functions can be provided through solar eclipses. N.W.

N82-22747*# United Technologies Corp., East Hartford, Conn.
MICROWAVE HEATING OF THE LOWER IONOSPHERE
G. MELTZ and W. L. NIGHAN *In* NASA, Washington The Final Proc. of the Solar Power Satellite Program Rev. p 403-406 Jul. 1980 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

Changes in the properties of the lower ionosphere due to ohmic heating of the plasma by the solar power satellite (SPS) microwave power beam are considered. The development of a predictive model of the underdense interaction of an electromagnetic beam and the lower ionosphere is described. The extent to which the Platteville and Arecibo experiments simulate SPS conditions is considered. J.D.

N82-23412# National Bureau of Standards, Washington, D.C. Thermophysical Properties Div.
HELIUM RESEARCH IN SUPPORT OF SUPERCONDUCTING POWER TRANSMISSION Annual Report, 1 Oct. 1979 - 1 Sep. 1980
D. E. DANEY, ed. Sep. 1981 45 p refs Sponsored in part by Brookhaven National Lab.
(PB82-122987; NBSIR-81-1649) Avail: NTIS HC A03/MF A01 CSCL 09C

In developing superconducting power transmission line cooldown strategies a computer code was used to explore cooldown times for a wide variety of realistic boundary conditions. Cooldown times of 10 days are feasible with only minor modification to previously proposed refrigeration systems if cooling channel lengths are reduced to two thirds or one half those dictated by steady state considerations. Evaluation of thermal flux meters was concluded. Below ground field tests revealed large effects due to seasonal variation in the soil heat flux. These effects are largely cancelled by algebraic addition of the signals from a pair of horizontally opposed sensors. A brief above ground field evaluation indicated that diurnal variations in the heat flux completely mask heat fluxes typical of the anticipated enclosure heat flux. GRA

N82-24261# Joint Publications Research Service, Arlington, Va.
COOPERATIVE EFFORT URGED FOR DEVELOPMENT OF ORBITAL POWER STATIONS
R. AKHMETOV *In its* USSR Rept.: Space, No. 15 (JPRS-80424) p 62-65 29 Mar. 1982 Transl. into ENGLISH from Sots. Industr. (USSR), 22 Oct. 1981 p 4
Avail: NTIS HC A07/MF A01

The concept of solar power stations is discussed in relation to construction, energy transmission, and support services. International interest and the benefits of international cooperation are considered. S.L.

N82-27362*# Aerospace Corp., El Segundo, Calif. 22a
ADVANCED SPACE SYSTEM CONCEPTS AND THEIR ORBITAL SUPPORT NEEDS (1980 - 2000)
J. BUTTS *In* NASA. Lewis Research Center Large Space Systems/Propulsion Interactions p 25-37 Jun. 1982
Avail: NTIS HC A12/MF A01

Possible uses of satellite technology up to the year 2000 are suggested and discussed. Included are electronic mail transmission, a personal communications capability, quick location of vehicles or shipments, monitoring of disputed territorial borders, upgraded scientific exploration of the universe, providing better maps of the Earth by remote sensing, space solar power stations and the safe transmission of the electrical energy to Earth, night lighting, and a small personal navigation capability. Support requirements are outlined. L.F.M.

N82-27405*# Massachusetts Inst. of Tech., Cambridge.
METALS PROCESSING
In its Mater. Process. Res. Base of the Mater. Process. Center p 268-284 28 Jun. 1982 refs
Avail: NTIS HC A13/MF A01 CSCL 11F

The metals processing effort is directed towards improvement of performance and usefulness of materials through modification and control of shape and internal structure. Interaction of reactive gases, introduced into a plasma arc, with iron alloys were analyzed. The technology of magnesium production was assessed. The study of fast fluidized bed reactors is continued. Aspects of separation processes are being investigated. The development of high field superconducting composites for use in large magnetic fusion devices is also discussed. Processing, structure, and property relationships of superconducting materials and the substitution of precious metals in standard electrical contact and connector applications are tested. The influence of processing procedures on the structure of zircaloy and nickel base alloys with a goal of improving mechanical properties and performance is investigated. Investigation of the potential of metal insulator semiconductor junctions as photovoltaic devices is reported. E.A.K.

N82-27664# Naval Ship Research and Development Center, Bethesda, Md. Propulsion and Auxiliary Systems Dept.
ACTIVE SUPERCONDUCTIVE GENERATOR DEVELOPMENT 400 HORSEPOWER GENERATOR DESIGN
H. O. STEVENS and M. J. CANNELL Oct. 1981 119 p refs (AD-A107513; DTNSRDC/PAS-81-14) Avail: NTIS HC A06/MF A01 CSCL 10B

A superconductive acyclic generator has been designed and constructed using the unique current-carrying capabilities of superconducting wire in the field winding to produce a very high flux density in the rotor region. This, along with the use of liquid-metal current collectors in lieu of conventional brushes has yielded a very high power density machine designed to operate at gas turbine speeds. The nominal 300-kilowatt generator is 0.66 meter long and 0.46 meter in diameter (26 x 18 inches) and is designed to operate at 19,500 revolutions per minute. Extrapolation of the design analyses indicates no barriers to operation up to 750 kilowatts. Efficiencies of 98% are estimated over the practical operating range. GRA

N82-27685# National Mechanical Engineering Research Inst., Pretoria (South Africa). Fluid Mechanics Div.
HYDRAULIC TRANSPORT OF COARSE SOLIDS IN CIRCULAR AND SEGMENTED PIPES
H. B. SAUERMANN May 1981 165 p refs
(CSIR-ME-1716; ISBN-0-7988-1479-9) Avail: NTIS HC A08/MF A01

A detailed investigation into the hydraulic transport of coarse solids in circular and segmented pipes is presented. The existing hydraulic transport pipelines carry relatively fine solids. It is believed that if coarse solids could be transported economically, many more hydraulic transport pipelines would come into operation. It is shown that by providing a wide bed, e.g., a base wear plate in a circular pipe (segmented pipe) to the sliding bed of coarse particles, the energy requirements for the same solids throughout in comparison with a circular pipe of the same diameter is, depending upon the position of the base wear plate and the solid material, reduced by up to 35%. Author

07

ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

A82-28650
METAL HYDRIDES FOR ENERGY STORAGE
D. G. IVEY and D. O. NORTHWOOD (Windsor, University, Windsor, Ontario, Canada) Canadian Metallurgical Quarterly, vol. 20, Oct.-Dec. 1981, p. 397-405. Research supported by the Natural Sciences and Engineering Research Council of Canada and Ontario Ministry of Energy. refs

Metal hydrides provide an efficient and safe method for storing hydrogen. Hydrogen can be stored indefinitely and released as needed for a number of energy usages. This paper conducts an overall review of the various alloys under consideration for hydrogen storage. The major classifications available are the AB compounds, AB5 compounds, and the AB2 or A2B compounds. Although none of these alloys fulfill storage criteria completely, a number of them show promise. (Author)

A82-31562
ENERGY STORAGE CAPACITY OF ROTATING COMPOSITE DISKS AND SHELLS /REVIEW/ [ENERGOEMKOST' VRASHCHAIUSHCHIKHSIA DISKOV I OBOLOCHEK IZ KOMPOZITOV /OBZOR/]
G. G. PORTNOV and IU. M. TARNOPOLSKII (Akademiia Nauk Latviiskoi SSR, Institut Mekhaniki Polimerov, Riga, Latvian SSR) (Vsesoiuznyi S'ezd po Teoreticheskoi i Prikladnoi Mekhanike, 5th, Alma-Ata, Kazakh SSR, May-June 1981.) Mekhanika Kompozitnykh Materialov, Mar.-Apr. 1982, p. 290-300. In Russian. refs

Research in the field of composite flywheels is briefly reviewed. Particular attention is given to the energy storage capacity of filament-wound structures and optimum shapes and reinforcement patterns for rotating shells. The maximum mass energy storage capacity of flywheels made from state-of-the-art composite materials is estimated at 400-800 J/g as compared with 100-200 J/g for steel flywheels. Energy storage capacities are calculated for filament-wound epoxy-matrix composite disks reinforced with glass, carbon, boron, and organic fibers. V.L.

A82-31563
ENERGY STORAGE CAPACITY OF ROTATING COMPOSITE STRUCTURES OPERATING UNDER UNIAXIAL TENSION [ENERGOEMKOST' VRASHCHAIUSHCHIKHSIA KONSTRUKTSII IZ KOMPOZITOV, RABOTAIUSHCHIKH NA ODNOOSNOE RASTIAZHENIE]
G. G. PORTNOV and V. A. POLIAKOV (Akademiia Nauk Latviiskoi SSR, Institut Mekhaniki Polimerov, Riga, Latvian SSR) Mekhanika Kompozitnykh Materialov, Mar.-Apr. 1982, p. 301-306. In Russian. refs

The energy storage capacity of filament-wound composite structures, such as rings, disks, and shells, is estimated using energy relationships derived from equilibrium equations. It is found that uniformly stressed structures have the highest energy storage capacity per specified mass. The maximum mass energy storage capacity is shown to be equal to one half of the specific material strength and is achieved in a thin ring. V.L.

A82-31841
VIBRATING ZINC ELECTRODES IN NI/ZN BATTERIES
M.-B. LIU, G. M. COOK, N. P. YAO (Argonne National Laboratory, Argonne, IL), and J. R. SELMAN (Illinois Institute of Technology, Chicago, IL) Electrochemical Society, Journal, vol. 129, May 1982, p. 913-920. Research supported by the U.S. Department of Energy. refs

It is noted that, in electrochemical processes where diffusion is rate controlling, the use of vibrating electrodes may result in an increase in the average mass transfer rate. The mechanism for this increase is that vibration changes the pattern of free convective flow developed during the process into a different flow pattern. Four models for the mass transfer enhancement are discussed and modified. An analysis is given of vibrating zinc electrodes in Ni/Zn batteries. The analysis comprises fluid dynamics, mass transfer, and electrochemical deposition phenomena. Consideration is also given to three types of fluid flows. The first, free-convective flow, is induced through the difference in the electrolyte density near the electrode and in the bulk. The other two, which are induced by the vibration of the zinc electrodes, are a periodic flow consisting of an oscillatory bulk flow and an oscillatory boundary flow, and a steady streaming near the upper and lower edges of the electrodes. A calculation is made of the mass-transfer coefficients of zincate and hydroxide ions. The morphology of the electrochemical deposition of zinc from alkaline zincate solution is related to ion-surface interactions. C.R.

A82-31869#
SOME THERMOPHYSICAL PROPERTIES OF PARAFFIN WAX AS A THERMAL STORAGE MEDIUM
A. HAJI-SHEIKH, J. EFTEKHAR, and D. Y. S. LOU (Texas, University, Arlington, TX) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, AIAA 7 p. Research supported by the University of Texas. refs
(AIAA PAPER 82-0846)

An experimental study is conducted to determine the suitability of paraffin wax SUNTECH P116 as a phase change material for storage of thermal energy. Certain temperature dependent thermophysical properties in the neighborhood of the melting point useful for this study, but not adequately available in the literature, are measured. They include thermal conductivity, density, thermal expansion coefficient, and viscosity. It is observed that the thermal conductivity of paraffin wax, in solid phase, is not a monotonic function of temperature as reported in the literature. Other thermophysical properties of the liquid phase measured vary monotonically with temperature. (Author)

A82-32373
A NEW TECHNIQUE FOR DETERMINING BATTERY INTERNAL RESISTANCE - STUDIES ON LECLANCHE CELLS
J. A. HAMILTON (Commonwealth Scientific and Industrial Research Organization, Institute of Earth Resources, Port Melbourne, Australia) Journal of Power Sources, vol. 7, Mar. 1982, p. 267-273. refs

A new technique for determining the internal resistance of batteries (and fuel cells) is described. The measuring circuit employs recently released VMOS field-effect transistors. The measurements do not require a storage or differential-input oscilloscope, and they can be performed in situ during battery discharge. The determination is similar to the constant-current, square-wave technique but is easier to use and does not rely on the use of approximations. Batteries can be tested without significant discharge because the mark-to-space ratio of the discharge pulse can be 0.1 percent. Data obtained on Leclanche cells using this technique are presented, showing the variation of internal resistance with discharge current and temperature.
(Author)

A82-35230
TRANSIT BUS PROPULSION EMPLOYING FLYWHEEL ENERGY STORAGE
L. J. LAWSON (Garrett AiResearch Manufacturing Co., Torrance, CA) Journal of Advanced Transportation, vol. 16, Spring 1982, p. 87-101. refs

A Flywheel Energy Storage System (FESS) concept is described for application to urban transit buses which undergo recharging at route intervals of 3-5 miles. A detailed description is given of the composite flywheel rotor and the synchronous induction motor by which the flywheel is both recharged and discharged, functioning as a generator for the powering of a traction motor that drives the rear axle of the bus in the discharge mode. The development of an automatic collector and enroute charging technique is expected to obviate an otherwise necessary delay of 90 sec for recharging. A technical review of FESS characteristics has demonstrated the feasibility of retrofit installation into the buses of three of the five manufacturers consulted on this possibility. Attention is given to production and life cycle costs, based on a product life of ten years. O.C.

A82-35488#
ENERGY STORAGE OPTIONS FOR HARNESSING WIND ENERGY
R. RAMAKUMAR (Oklahoma State University, Stillwater, OK) American Society of Mechanical Engineers, Energy-Sources Technology Conference and Exhibition, New Orleans, LA, Mar. 7-10, 1982, 6 p. Research supported by the Oklahoma State University. refs
(ASME PAPER 82-PET-9) MEMBERS, $2.00; NONMEMBERS, $4.00

The inherent variability of the wind energy resource necessitates either an energy storage and reconversion system or a back-up unit to supply customers 'on demand'. A brief survey of the technical aspects of the various energy storage and reconversion options proposed for use with wind energy conversion systems is presented. Energy can be stored in mechanical, chemical, thermal, or electrical form. The schemes discussed include hydrofirming, compressed air, flywheels, hydrogen, secondary batteries, and thermal storage. (Author)

A82-35525
NEW PERSPECTIVES FOR KINETIC ENERGY STORAGE
J.-P. BARTHELEMY (Societe Nationale Industrielle Aerospatiale, Les Mureaux, Yvelines, France) In: Energy conservation and thermal insulation. Chichester, Sussex, England, John Wiley and Sons, Ltd., 1981, p. 689-698.

Research on flywheels has produced fully integrated systems comprising a rotor, magnetic suspension, a motor-generator, and associated electronics. This makes it possible to introduce energy in electric form, store it in kinetic form, and recover it in electric form, the wheel being placed in a vacuum container for ground operations. A description is given of magnetic bearings and associated subsystems, with attention given to the passive permanent-magnet radial bearings, active electromagnetic axial bearing, axial servoloop, radial dampers, motor, emergency bearings, and electronics. It is shown that the main functional hardware can be adapted to ground applications without significant new developments for a range below 3 kW in power and 1 kWh in deliverable energy. Here, no special rooms or large surfaces are needed. Because of the inherent reliability of magnetic suspension, no maintenance is necessary. C.R.

A82-36256
NEW DEVELOPMENTS IN BATTERY TECHNOLOGY
J. GRAY (Chloride Group, Ltd., London, England) Endeavour, vol. 6, no. 2, 1982, p. 78-82.

Practical, high energy density alternatives to the lead-acid battery are considered for both vehicular and utility load-leveling use, in view of year 2000 potential markets. After demonstrating the high costs and low energy densities and life cycles of lead/acid, nickel/iron and nickel/zinc systems, as well as batteries using gaseous electrodes such as the nickel/hydrogen system employed by communication satellites and those taking advantage of light metals like lithium and sodium, a description is given of the design features and operational characteristics of the sodium/sulfur battery. Attention is given to both internal and external sodium volume battery configurations, both of which employ beta alumina as a solid electrolyte with high sodium ion conductivity, and molten sodium and sulfur at 350 C. It is the thermal insulation of the sodium/sulfur battery that makes its application to electric vehicles difficult, despite a very high energy density. O.C.

A82-36317
AN INNOVATION WHICH COMES FROM SPACE - KINETIC ENERGY STORAGE [UNE INNOVATION QUI VIENT DE L'ESPACE - LE STOCKAGE CINETIQUE D'ENERGIE]
J.-P. BARTHELEMY (Societe Nationale Industrielle Aerospatiale, Les Mureaux, Yvelines, France) La Recherche, vol. 12, Oct. 1981, p. 1162-1164. In French.

The potential ground-based applications of the technology of energy storage in a rotating flywheel, which was developed for use in satellites, are discussed. Problems of the conventional flywheel as used in satellite energy storage systems are identified, including limited storage capacity and losses due to wear, limited life and low autonomy, and solutions offered by the use of composite materials on the one hand and magnetic suspension are pointed out. The design of a kinetic energy battery making use of magnetic levitation and currently undergoing tests as a reserve energy supply for a rural telephone system is then presented, and the operational advantages of such a system with respect to an electrochemical cell are pointed out. A.L.W.

A82-37076#
COMPOSITES IN ENERGY GENERATION AND STORAGE SYSTEMS - AN OVERVIEW
R. W. FULMER (Owens Corning Fiberglas Corp., Fiberglas Composites and Equipment Marketing Div., Toledo, OH) In: Reinforced Plastics/Composites Institute, Annual Conference, 36th, Washington, DC, February 16-20, 1981, Preprints. New York, Society of the Plastics Industry, Inc., 1981 (Session 22-A). 8 p. refs

Applications of glass-fiber reinforced composites (GER) in renewable and high-efficiency energy systems which are being developed to replace interim, long-term unacceptable energy sources such as foreign oil are reviewed. GFR are noted to have design flexibility, high strength, and low cost, as well as featuring a choice of fiber orientation and type of reinforcement. Blades, hub covers, nacelles, and towers for large and small WECS are being fabricated and tested and are displaying satisfactory strength, resistance to corrosion and catastrophic failure, impact tolerance, and light weight. Promising results have also been shown in the use of GFR as flywheel material for kinetic energy storage in conjunction with solar and wind electric systems, in electric cars, and as load levellers. Other applications are for heliostats, geothermal power plant pipes, dam-atoll tidal wave energy systems, and intake pipes for OTECs. M.S.K.

N82-22498# Rocketdyne, Canoga Park, Calif.
RPE-10 COMPOSITE FLYWHEEL TESTING Final Report
B. R. GINSBURG 15 Jun. 1981 47 p refs Prepared for California Univ., Livermore. Lawrence Livermore Lab.
(Contract W-7405-ENG-48)
(UCRL-15379; RI-RD81-166) Avail: NTIS HC A03/MF A01

A final report on the technical efforts in testing an RPE-10 composite flywheel is presented. The RPE-10 composite flywheel (unit no. 2) designed and fabricated for vehicle use, was tested to a speed of 21,600 rpm, at which time the overwrap separated from the flywheel, terminating the test. The primary cause of failure was attributed to overheating in the test cell, causing a deterioration in material properties of the epoxy bond. The RPE-10 composite flywheel unit no. 1 was successfully tested without failure to 24,120 rpm. At this speed, the rotor stored over 2.0 kilowatt hours of kinetic energy. M.D.K.

N82-22773# Sargent and Lundy, Engineers, Chicago, Ill.
COMPRESSED-AIR ENERGY STORAGE: PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 3B: SITE SELECTION STUDY, PART 2 Final Report
W. C. WALKE 31 Jul. 1981 24 p refs Sponsod by EPRI Prepared in cooperation with Public Service Co. of Indiana, Inc.
(Contract DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI PROJ. RP-1081-3)
(DE82-000674; DOE/ET-29232/T4-VOL-3B) Avail: NTIS HC A02/MF A01

Fourteen sites considered to have potential for development with a 1000 MW compressed air energy storage (CAES) plant were identified by the Illinois State Geological Survey (ISGS) and the Indiana Geological Survey (IGS). The relative desirability of developing each of these sites was evaluated from the standpoints of geology, economics, air quality/meteorology, cultural resources, and ecology. Preliminary site layouts were developed for each of the 14 sites. Sites that were found to be incapable of supporting a 1000 MW plat, or that would require more than 2000 air injection-withdrawal wells to do so, were eliminated from consideration. The seven remaining top-ranked sites were then selected for further study. T.M.

N82-22789# Institut fuer Kemtechnik und Energiewandlung e.V., Stuttgart (West Germany).
LATENT HEAT THERMAL ENERGY STORAGE: DETERMINATION OF PROPERTIES OF STORAGE MEDIA AND DEVELOPMENT OF A NEW TRANSFER SYSTEM Final Report, Jun. 1980
A. ABHAT, S. ABOUL-ENEIN, and N. A. MALATIDIS Bonn Bundesministerium fuer Forschung und Technologie Jan. 1982 193 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-016; ISSN-0340-7608) Avail: NTIS HC A09/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 34,80

A latent heat storage system for low temperature solar heating applications was developed. Latent heat storage materials were studied and a heat exchanger design was evaluated. Thermophysical properties of 14 organic and inorganic heat storage materials, including 5 inexpensive commercial paraffins, 2 fatty acids, and 5 salt hydrates, were measured with a precision differential scanning calorimeter. Data pertaining to phase transition temperature, enthalphy and, specific heat of the heat storage materials in solid and liquid phases were taken. The influence of thermal cycling on the melting and freezing behavior of the materials and on changes in thermophysical properties was analyzed. A heat exchanger with finned annulus heat exchanger elements was investigated. Tests were performed, using two laboratory models that employed a paraffin, two fatty acids and one salt hydrate as heat storage materials. Author (ESA)

N82-22843# Technische Universitaet, Brunswick (West Germany). Inst. fuer Physikalische Chemie.
INVESTIGATIONS TO PREDICT AND REDUCE THE EVAPORATION RATE OF THE RESIDUAL BRINE IN SALT CAVERNS USED FOR GAS STORAGE Final Report, Dec. 1980
H. J. PETRICK, H. K. CAMMENGA, and D. HERZ Bonn Bundesministerium fuer Forschung und Technologie Dec. 1981 42 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-81-226; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8,60

Tensides were tested for their ability to reduce the evaporation rate of residual brine in salt caverns used for gas storage. Fatty alcohols with more than 20 CH2 groups and perfluorinated alcohols with more than 12 CF 2 groups prove especially useful. The formation of a solid salt crust on the initialy free brine surface is due to the incorporation of alkaline Earth ions. After its completion, the solid salt crust enormously reduces the evaporation rate of the underlying brine. It is found that by the use of different tensides, crust formation can be either enhanced of retarded at will.
Author (ESA)

N82-23735# Public Service Co. of Indiana, Plainfield.
COMPRESSED-AIR ENERGY STORAGE: PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 1: EXECUTIVE SUMMARY Final Report
T. W. MCCAFFERTY, W. C. WALKE, and J. S. BONK 31 Jul. 1981 133 p Prepared in cooperation with Sargent and Lundy, Engineers and Westinghouse Electric Corp., Concordville, Pa. 9 Vol.
(Contract DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI PROJ. RP-1081-3)
(DE82-000270; DOE/ET-29232/T4-VOL-1) Avail: NTIS HC A07/MF A01

The behavior and suitability of an aquifer-based compressed air energy storage (CAES) facility were investigated. The project was part of a five-phase program to promote compressed air energy storage and underground pumped hydro in the United States. The background, project organization, and summarization of all project work are provided. T.M.

N82-23736# Public Service Co. of Indiana, Plainfield.
COMPRESSED-AIR ENERGY STORAGE: PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 3A: SITE SELECTION STUDY, PART 1 Final Report
W. C. WALKE 31 Jul. 1981 121 p refs Prepared in cooperation with Sargent and Lundy, Engineers 9 Vol.
(Contract DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI PROJ. RP-1081-3)
(DE82-000675; DOE/ET-29232/T4-VOL-3A) Avail: NTIS HC A06/MF A01

A preferred ranking for aquifer sites potentially capable of supporting a CAES facility is provided. The study area that was investigated for possible aquifer storage sites comprises roughly the Illinois and Indiana portions of the geologic structure known as the Illinois Basin. Sites in Illinois and Indiana adjacent to the Illinois Basin that appeared suitable geologically were also investigated. Potential sites in this area were identified by the Illinois State Geological Survey (ISGS) and the Indiana Geological Survey (IGS). T.M.

N82-23737# Public Service Co. of Indiana, Plainfield.
COMPRESSED-AIR ENERGY STORAGE: PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AQUIFER. VOLUME 6: BALANCE OF PLANT DESIGN Final Report
31 Jul. 1981 534 p refs Prepared in cooperation with Sargent and Lundy, Engineers 9 Vol.
(Contract DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI PROJ. RP-1081-3)
(DE82-000670; DOE/ET-29232/T4-VOL-6) Avail: NTIS HC A23/MF A01

The behavior and suitability of an aquifer-based compressed-air energy storage (CAES) plant was studied. Methodologies and preliminary design procedures for developing, designing, constructing, and operating a CAES facility utilizing an aquifer storage formation were established earlier. The balance of plant design considerations for a CAES plant are given. The design of the above ground facilities including well locations, fuel oil storage, switchyard, facility access, plant and equipment arrangement, and process flow diagrams are discussed. DOE

N82-23738# Public Service Co. of Indiana, Plainfield.
COMPRESSED-AIR ENERGY STORAGE: PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 7: ENVIRONMENTAL, SAFETY, AND LICENSING CONSIDERATIONS Final Report
31 Jul. 1981 364 p refs Prepared in cooperation with Sargent and Lundy, Engineers 9 Vol.
(Contract DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI PROJ. RP-1081-3)
(DE82-000669; DOE/ET-29232/T4-VOL-7) Avail: NTIS HC A16/MF A01

The behavior and suitability of aquifers as compressed-air energy storage (CAFS) sites was studied. The probability, severity, and recommended control measures for the environmental and safety impacts that could result from the construction and operation of a CAES facility are described. The permits and approvals that would be required and the time estimated for their acquisition are also described. DOE

N82-23739# Public Service Co. of Indiana, Plainfield.
COMPRESSED-AIR ENERGY STORAGE: PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 8: AQUIFER FLOW CODE SIMULATION Final Report
D. L. AYERS 31 Jul. 1981 301 p refs Prepared in cooperation with Westinghouse Electric Corp., West Lafayette, Ind. 9 Vol.
(Contract DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI PROJ. RP-1081-3)
(DE82-000668; DOE/ET-29232/T4-VOL-8) Avail: NTIS Hc A10/MF A01

The behavior and suitability of an aquifer-based compressed air energy storage (CAES) plant were investigated. Methodologies and preliminary design procedures for developing, designing,

constructing, and operating a CAES facility utilizing an aquifer storage formation were established. Descriptions, development, and results from a one-dimensional air flow computer model, two-dimensional air flow computer model, and a manifold air flow/pressure loss model are provided. These models are analytic tools used to predict aquifer performance and CAES system analysis. DOE

N82-23740# Public Service Co. of Indiana, Plainfield.
COMPRESSED-AIR ENERGY STORAGE: PRELIMINARY DESIGN AND SITE DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 9: COST ESTIMATE AND SCHEDULE Final Report
31 Jul 1981 115 p refs Prepared in cooperation with Sargent and Lundy, Engineers 9 Vol.
(Contract DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI PROJ. RP-1081-3)
(DE82-000667; DOE/ET-29232/T4-VOL-9) Avail: NTIS HC A06/MF A01

The engineering and construction schedule, facilities capital cost estimate and corresponding cash flow requirements relative to the construction of a compressed-air energy storage facility on an aquifer site is discussed. DOE

N82-23753# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES. UPH, APPENDIX D: POWER PLANT Final Report
Jun. 1981 607 p Sponsored in part by Electric Power Research Inst. Prepared for Potomac Electric Power Co., Washington, D.C.
(Contract DE-AC02-77ET-28013; EPRI PROJ. 1081-1)
(DE82-003075; EPRI-EM-1589-VOL-8-APP-D; DOE/ET-5047/8.D) Avail: NTIS HC A99/MF A01

Studies were undertaken to determine power plant arrangements for a single stage reversible pump turbine two step underground pumped hydro (UPH) installation and for a multi-stage reversible pump turbine single step (MSRPT) UPH installation. Arrangements consist of: the underground powerhouses; transformer galleries; associated mechanical and electrical equipment; the administration and control building; hoist head frames; the access; draft tube and bus tunnels; and the switchyard. Primary considerations including the number and size of pump turbine and motor generator units, starting methods, transformers, high voltage connections, geotechnical and construction aspects and safety were studied. A feasibility analysis to minimize costs was conducted. The study led to the selection of suitable equipment and layouts for the powerhouses, transformer galleries, and associated facilities. The material presented and also the cost estimates are based on the requirements for a 2000 MW plant providing 20,000 MWh of storage with a nominal head of 4600 ft. DOE

N82-23764# Massachusetts Inst. of Tech., Cambridge.
PHOTOCHEMICAL ENERGY STORAGE: STUDIES OF INORGANIC PHOTOASSISTANCE AGENTS Progress Report, 17 Dec. 1980 - 14 Sep. 1981
M. S. WRIGHTON Sep. 1981 31 p refs
(Contract DE-AS02-76ER-04178)
(DE82-000403; DOE/ER-04178/5) Avail: NTIS HC A03/MF A01

Work concerning the use of certain n- and p-type semiconductors, including Si, InP, WS2, TiO2, and SrTiO3, as photoelectrode materials in photoelectrohemical cells for optical energy conversion is reported. Additionally, intrinsic a-Si:H on a stainless steel substrate was characterized where the contact to the stainless steel is a thin, heavily doped n-type layer resulting in an ohmic contact near the conduction band. Study of p-type Si bearing a redox polymer/Pt(O) or Pd(O) catalyst system was ongoing and improvements in photoelectrochemical H2 generation via surface catalysis were demonstrated. Highlights of the accomplishments so far are: (1) the demonstration that n-type WS2-based photoelectrochemical cells can be used to sustain the uphill conversion of SO2 and H2O to H2SO4 and H2 in 50% by weight H2SO4; (2) establishment of the behavior of photoconductor (a-Si:H) electrodes in contact with liquid electrolytes. DOE

N82-23771# Acres American, Inc., Buffalo, N.Y.
PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 11: PLANT DESIGN. UPH Final Report
Jun. 1981 379 p refs Prepared in cooperation with Potomac Electric Power Co. 13 Vol.
(Contract DE-AC02-77ET-28012; EPRI PROJ. 1981-1)
(DE82-000918; EPRI-EM-1589-VOL-11; DOE/ET-5047/11) Avail: NTIS HC A17/MF A01

The plant design for an underground pumped hydroelectric (UPH) storage facility having maximum generating capacity of 2000 MW and energy storage capacity of 20,000 MWh at a nominal heat of 5000 ft. is presented. The UPH facility is a two step configuration with single-stage reversible pump-turbines, each step consisting of a 1000 MW plant at a nominal head of 2500 ft. The surface facilities and upper reservoir, shafts and hoists, penstocks and hydraulic tunnels, powerhouses, and intermediate and lower reservoirs are described. Details of the power plant electrical and mechanical equipment, including pump-turbine and motor-generator units, are given. The development of the site is outlined together with the construction methods and schedule. The cost estimates and a cost-risk analysis are presented. Plant operation, including unit operation, two-step operation, plant efficiency, and availability, is outlined. T. M.

N82-23781# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
ENERGY PROGRAMS AT THE JOHN HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report, Apr. - Jun. 1981
Jul. 1981 37 p refs Sponsored in part by DOE
(PB82-126699; JHU/APL/EQR/81-2) Avail: NTIS HC A03/MF A01 CSCL 10A

Efforts in geothermal energy development planning and technical assistance, energy conversion and storage techniques, siting of critical facilities, magnetic fusion and mathematical models of fires are briefly described. GRA

N82-24652# Courtesy Associates, Inc., Washington, D.C.
PROCEEDINGS OF THE DOE THERMAL AND CHEMICAL STORAGE ANNUAL CONTRACTOR'S REVIEW MEETING
Mar. 1981 361 p refs Meeting held at McLean, Va., 14-16 Oct. 1980 Prepared for Brookhaven National Lab.
(Contract DE-AC02-76CH-00016)
(CONF-801055) Avail: NTIS HC A16/MF A01

Overviews of Thermal Energy Storage and Chemical/Hydrogen Energy Storage Programs are presented. The progress and accomplishments of each subcontractor, program management and interested researchers from industry, academia, and government are summarized.

N82-24653# Department of Energy, Washington, D. C. Thermal and Chemical Storage Branch.
OVERVIEW OF THE THERMAL ENERGY STORAGE (TES) PROGRAM
M. GUREVICH *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 1-2 Mar. 1981
Avail: NTIS HC A16/MF A01

The program promotes energy savings and fuel substitution by developing and helping to commercialize technologies for storing heat or cold, with shot investment payback periods as a cost goal. The sources of energy include industrial and utility waste heat as well as primary sources such as solar, geothermal, nuclear and fossil fuels. The primary source of 'cold' for seasonal storage is winter chilled air. The program emphasizes near-term (1980's) approaches to energy conservation and displacement of natural gas and oil. It also provides for development of technologies which will allow use of renewable resources such as solar-thermal energy

during the mid-term (1990's) and advanced energy storage and transport techniques for the far-term (beyond 2000). T.M.

N82-24654# Oak Ridge National Lab., Tenn.
ORNL THERMAL ENERGY STORAGE PROGRAM OVERVIEW
J. F. MARTIN *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 3-10 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

Development of thermal energy storage (TES) technologies and subsystems is relevant to national energy objectives in energy conservation and in the deployment of new energy soucss. Oak Ridge National Laboratory (ORNL) acts as a Lead Technical Laboratory in managing for DOE-STOR those elements of the program dealing with building heating and cooling, and industrial applications. The scope of ORNL activity in these two activities is described, and a summary of each of the in-house and subcontracted projects current or anticipated for the next fiscal year are presented. The major thrust of each of the elements of the ORNL program is given. Author

N82-24655# New York State Energy Research and Development Authority, Albany.
DESIGN AND DEMONSTRATION OF A STORAGE-ASSISTED AIR CONDITIONING SYSTEM
J. E. RIZZUTO *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 11-14 Mar. 1981
Avail: NTIS HC A16/MF A01

The system is a peak-shaving system designed to provide a levelized air conditioning load. The system also requires minimum air conditioner and thermal storage capacity. The storage-assisted air conditioning system uses a Glauber's salt-based phase change material in sausage like containers called CHUBS. The CHUBS are two (2) inches in diameter and 20 inches long. They are stacked in modules of 64 CHUBS which are appropriately spaced and oriented in the storage system so that air may pass perpendicular to the long axis of the CHUBS. The phase change material, has a thermal storage capacity in the range of 45 to 50 Btu/lb and a transition temperature of approximately 55 F. T.M.

N82-24656# Argonne National Lab., Ill.
EXPERIMENTAL EVALUATION OF THERMAL ENERGY STORAGE Status Report
H. N. HERSH *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 15-17 Mar. 1981
Avail: NTIS HC A16/MF A01

Thermal energy storage (TES) for space heating is a load management technique that is successfully used in Europe. Results from the ANL assessment of energy storage technologies indicated that customer owned TES units of the type used in Europe could provide a cost-effective means for utility load management in the U.S. It is only necessary, therefore, that the technical and economic viability of this technology be examined under the U.S. climatic, institutional and other conditions. T.M.

N82-24662# Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
THERMAL ENERGY STORAGE TESTING FACILITY
R. J. SCHOENHALS, C. P. LIN, H. F. KUEHLERT, and S. H. ANDERSON *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 33-36 Mar. 1981 refs
(Contract W-31-109-38-4666)
Avail: NTIS HC A16/MF A01

Development of a prototype testing facility for performance evaluation of electrically heated thermal energy storage units is described. Laboratory apparatus and test procedures were evaluated by means of measurements and analysis. A 30kW central unit and several smaller individual room-size units were tested. T.M.

N82-24665# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
PERFORMANCE OF STRATIFIED THERMAL STORAGE SYSTEM FOR OLIVER SPRINGS ELEMENTARY SCHOOL Progress Report
R. L. REID and A. F. G. BEDINGER *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 44-46 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

A progress report on the performance of a stratified thermal storage system coupled with a heat recovery refrigeration machine designed to provide space heating, cooling, and service water heating is presented. Water storage tanks utilizing a flexible membrane to resist temperature blending will be used as the thermal storage element. The two design goals of the heat recovery and thermal energy storage system are: (1) to minimize the need to purchase energy for space heating and cooling and water heating, and (2) to minimize electrical demand. An automatic data acquisition system will be used for system performance data gathering. M.D.K.

N82-24667# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
DIRECT CONTACT HEAT TRANSFER FOR THERMAL ENERGY STORAGE
J. D. WRIGHT *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 50-53 Mar. 1982 refs
Avail: NTIS HC A16/MF A01

Direct contact heat exchange offers the potential for increased efficiency and lower heat transfer costs in a variety of thermal energy storage systems. SERI models of direct contact heat transfer based on literature information identified dispersed phase drop size, the mechanism of heat transfer within the drop, and dispersed phase holdup as the parameters controlling direct contact system performance. Tests were defined and equipment constructed to provide independent determination of drop size, heat transfer mechanism, and hold up. Further experiments are needed to conclusively determine whether the salt in a salt hydrate melt acts to block internal circulation. The potential of low temperature oil/salt hydrate latent heat storage systems is being evaluated in the laboratory. M.D.K.

N82-24668# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
SYSTEMS ANALYSIS OF THERMAL STORAGE
R. J. COPELAND *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 54-57 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

During FY80 analyses were conducted on thermal storage concepts for solar thermal applications. These studies include both estimates of the obtainable costs of thermal storage concepts and their worth to a user (i.e., value). Based on obtainable costs and performance, promising thermal storage concepts are being identified. A preliminary screening was completed in FY80 and a more in-depth study was initiated. Value studies are being conducted to establish cost goals. A ranking of storage concepts based on value in solar thermal electric plants was conducted for both diurnal and long duration applications. Ground mounted thermal storage concepts for a parabolic dish/Stirling system are also being evaluated. Author

N82-24670# Institute of Gas Technology, Chicago, Ill.
HIGH-TEMPERATURE MOLTEN SALT THERMAL ENERGY STORAGE SYSTEMS FOR SOLAR APPLICATIONS
R. J. PETRI and T. D. CLAAR *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 60-64 Mar. 1982 refs
Avail: NTIS HC A16/MF A01

A plan for the selection and testing of latent-heat alkali and alkaline earth carbonate storage salts, containment materials, and thermal conductivity enhancement (TCE) materials for use in

high-temperature (704 to 871 C) thermal energy storage systems utilizing advanced solar-thermal power generation concepts is described. Screening of candidate salt/containment/TCE materials combinations will be performed. Results of these compatibility tests will lead to the selection of materials combinations that meet anticipated solar power system requirements. Needs for more reliable thermophysical and transport property data will be identified and measurements will then be performed on these salts to support the scale-up of solar-thermal TES subsystems. M.D.K.

N82-24671# Grumman Aerospace Corp., Bethpage, N.Y.
ACTIVE HEAT EXCHANGE: SYSTEM DEVELOPMENT FOR LATENT HEAT THERMAL ENERGY STORAGE
J. ALARIO and R. HASLETT *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 65-67 Mar. 1981
Avail: NTIS HC A16/MF A01

An active heat exchange method in a latent heat (salt) thermal energy storage system that prevents a low conductivity solid salt layer from forming on heat transfer surfaces was developed. An evaluation of suitable media with melting points in the temperature range of interest (250 to 400 C) limited the candidates to molten salts from the chloride, hydroxide, and nitrate families, based on high storage capacity, good corrosion characteristics, and availability in large quantities at reasonable cost. The specific salt recommended for laboratory tests was a choride eutectic (20.5KCl, 24.5NaCl, 55.0MgCl2 percent by wt.), with a nominal melting point of 385 C. Author

N82-24672# Naval Research Lab., Washington, D. C.
THE 1980 REPORT ON NRL ENERGY STORAGE PROGRAM
T. A. CHUBB, J. J. NEMECEK, D. E. SIMMONS, and R. J. VEITH *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 68-72 Mar. 1981
Avail: NTIS HC A16/MF A01

The development of a means for bulk storage of energy in a form capable of providing demand sensitive steam, heat, or cooling is described. Salt eutectic systems availability and costs of salts, progress on the 2 MWht energy storage boiler tank under construction at NRL, and major elements of storage system costs for this 2 MWht tank which employs a heat transfer fluid are discussed. A radiation coupled energy storage tank concept is also discussed. Author

N82-24674# TRW, Inc., Oak Ridge, Tenn.
THERMAL ENERGY STORAGE FOR RESIDENTIAL ENERGY CONSERVATION
D. GOLDENBERG *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 79-83 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

The potential for conservation of oil and gas was evaluated for thermal energy storage applications involving waste heat recovery and passive solar systems for houses that have gas- or oil-fired furnaces. A waste heat recovery device using pebbles as the TES medium increases furnace seasonal efficiency to 95%. Passive solar system performance was estimated from work sponsored by the Department of Energy. Potential market sizes and penetrations were evaluated by region to determine national oil and gas savings. The total oil and gas savings for the year 2000 were estimated to be 0.22 quads/year for the furnace waste heat recovery device and 0.10 quads/year for passive solar systems installed in houses heated by gas or oil furnaces. Author

N82-24680# Sandia Labs., Albuquerque, N. Mex. Fluid Mechanics and Heat Transfer Div.
STATUS REPORT OF THERMOCLINE THERMAL ENERGY STORAGE STUDIES AT SANDIA NATIONAL LABORATORIES
R. J. GROSS and R. W. HARRIGAN *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 104-108 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

The thermocline thermal energy storage concept was evaluated to fulfill the needs of solar thermal energy systems. A 1200 gallon engineering prototype tank was constructed and tested. Component development and computer code verification were initiated. Analytical modeling, both one and two-dimensional was also initiated. The feasibility of thermocline storage and the maximum expected performance, in both an engineering and economic sense, are to be determined. M.D.K.

N82-24683# General Electric Co., Evendale, Ohio.
STORAGE REQUIREMENTS DEFINITION AND SRE DESIGN FOR DISH STIRLING SYSTEMS
W. F. ZIMMERMAN, L. E. STACY, and G. C. WESLING *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 118-122 Mar. 1981
Avail: NTIS HC A16/MF A01

A direct dish Stirling solar receiver (DSSR) and a heat pipe solar receiver with TES (HPSR) are described. Cost effectiveness and thermal performance, analyzed minute by minute over one year of solar insolation are included. Using existing designs of these two receivers, parametric performance and cost studies to determine the influences of adding varying amounts of TES to the DSSR, and of providing fossil fuel combustion, and of varying the levels of TES in the HPSR are discussed. The thermal modeling of the two receivers was completed and the criteria and programming for the economic analysis were documented. Author

N82-24684# Ford Aerospace and Communications Corp., Newport Beach, Calif. Aeronutronic Div.
THERMAL ENERGY BUFFER STORAGE FOR THE SMALL COMMUNITY SOLAR THERMAL POWER EXPERIMENT
R. E. POLZIEN *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 123-128 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

The application of a latent heat thermal energy buffer storage (TEBS) subsystem to the small community solar thermal power experiment (SCSE) is discussed. The SCSE consists of multiple point focusing distributed receiver (PFDR) power modules equipped with an organic Rankine cycle power conversion unit mounted at the focus of each paraboloidal concentrator. The objective of the TEBS is to minimize plant shutdowns during intermittent cloud coverages, thereby improving life expectancy of the major subsystems with attendant reduction in capital investment and maintenance costs. An SCSE plant performance model modified for operation with a TEBS system is used with time varying insolation to show that 70 to 80 percent of the potential engine shutdowns due to insolation dropout may be averted with the TEBS system. Results of preliminary design analyses of various TEBS concepts are discussed. Author

N82-24685# Rocket Research Corp., Redmond, Wash.
APPLICATION OF THERMAL ENERGY STORAGE TO PROCESS HEAT RECOVERY IN THE ALUMINUM INDUSTRY
L. B. KATTER *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 129-132 Mar. 1981
Avail: NTIS HC A16/MF A01

The economic viability and institutional compatibility of a district heating system that uses waste heat from an aluminum plant as the source of thermal energy are discussed. The project was designed to show how existing energy storage techniques can enhance the utility of low temperature waste heat streams. Author

N82-24686*# Edde (Howard), Inc., Bellevue, Wash.
COLLECTION AND DISSEMINATION OF THERMAL ENERGY STORAGE SYSTEM INFORMATION FOR THE PULP AND PAPER INDUSTRY
H. EDDE *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 133-136 Mar. 1981 refs
(Contract DEN3-190)
Avail: NTIS HC A16/MF A01 CSCL 10A

The collection and dissemination of thermal energy storage (TES) system technology for the pulp and paper industry with the intent of reducing fossil fuel usage is discussed. The study plan is described and a description presented of example TES systems. Author

N82-24687# Heinz (H. J.) Co., Pittsburgh, Pa.
APPLICATIONS OF THERMAL ENERGY STORAGE TO WASTE HEAT RECOVERY IN THE FOOD PROCESSING INDUSTRY
G. J. TREBILCOX and W. L. LUNDBERG (Westinghouse Electric Corp., Pittsburgh, Pa.) *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 137 Mar. 1981
(Contract EC-77-C-01-5002)
Avail: NTIS HC A16/MF A01

The canning segment of the food processing industry is a major energy user within that industry. Most of its energy demand is met by hot water and steam and those fluids, in addition to product cooling water, eventually flow from the processes as warm waste water. To minimize the possibility of product contamination, a large percentage of that waste water is sent directly to factory drains and sewer systems without being recycled and in many cases the thermal energy contained by the waste streams also goes unreclaimed and is lost from further use. Waste heat recovery in canning facilities can be performed economically using systems that employ thermal energy storage (TES). A project was proposed in which a demonstration waste heat recovery system, including a TES feature, would be designed, installed and operated. Author

N82-24688# Burns and Roe, Inc., Oradell, N. J.
ONCE-THROUGH HEAT SUPPLY SYSTEM FOR CITY OF BELLINGHAM
I. OLIKER *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 138-140 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

Technical aspects of a once-through system are discussed. Waste heat utilization, space heating, and heat storage, are discussed. N.W.

N82-24691# Rocket Research Corp., Redmond, Wash.
THE SULFURIC ACID/WATER CHEMICAL HEAT PUMP/ENERGY STORAGE PROGRAM
E. C. CLARK, D. K. CARLSON, and O. M. MORGAN *In* Courtesy Associates, Inc. Proc. of the DOE Thermal and Chem. Storage Ann. Contractor's Rev. Meeting p 150-153 Mar. 1981 refs
Avail: NTIS HC A16/MF A01

A large-scale verification test unit was designed which incorporates many commercial mass producible design features and materials. The nominal storage capacity is 1,000,000 Btu, with a power rating equal to 150,000 Btu/hr. An engineering model CHP/CES system was designed, fabricated, and tested closed loop with a nominal 25,000 Btu/hr charge and discharge rate and 150K to 300K Btu storage capacity, depending on the number of tanks. Preliminary testing of commercial grade acid plumbing and valves is complete with no equipment failures. Author

N82-25640*# Giner, Inc., Waltham, Mass.
REQUIREMENTS FOR OPTIMIZATION OF ELECTRODES AND ELECTROLYTE FOR THE IRON/CHROMIUM REDOX FLOW CELL Final Report
V. JALAN, H. STARK, and J. GINER Sep. 1981 82 p refs
(Contract DEN3-97; DE-AI04-80AL-12726)
(NASA-CR-165218; DOE/NASA/0097-80/1; NAS 1.26:165218)
Avail: NTIS HC A05/MF A01 CSCL 10C

Improved catalyzation techniques that included a pretreatment of carbon substrate and provided normalized carbon surface for uniform gold deposition were developed. This permits efficient use of different batches of carbon felt materials which initially vary significantly in their physical and surface chemical properties, as well as their electrochemical behavior. Further modification of gold impregnation technique gave the best performing electrodes. In addition to the linear sweep voltammetry, cyclic voltammetry was used to determine the effects of different activation procedures on the Cr(3)/Cr(2) Redox and H2 evolution reactions. The roles of carbon, gold and lead in the overall Redox cycle are identified. The behavior of the electrodes at both normal battery operating potentials and more extreme potentials is discussed preparing efficient and stable electrodes for the energy storage battery is implicated. E.A.K.

N82-26048*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
VEHICLE TEST REPORT: JET INDUSTRIES ELECTRA VAN 600
T. W. PRICE and V. A. WIRTH, JR. 15 Feb. 1982 50 p refs
(Contract NAS7-100; DE-AI01-78CS-54209)
(NASA-CR-168986; JPL-PUB-82-36; NAS 1.26:168986; DOE/CS-54209/9) Avail: NTIS HC A03/MF A01 CSCL 13F

The Electra Van 600, an electric vehicle, was tested. Tests were performed to characterize parameters of the Electra Van 600 and to provide baseline data to be used for comparison of improved batteries and to which will be incorporated into the vehicle. The vehicle tests concentrated on the electrical drive subsystem, the batteries, controller, and motor; coastdowns to characterize the road load and range evaluation for cyclic and constant speed conditions; and qualitative performance was evaluated. It is found that the Electra Van 600 range performance is approximately equal to the majority of the vehicles tested previously. E.A.K.

N82-26809# Eagle-Picher Industries, Inc., Joplin, Mo.
NICKELZINC BATTERIES FOR RPV APPLICATIONS Interim Technical Report, 15 Dec. 1979 - 15 Nov. 1980
D. DAPPERT Wright-Patterson AFB, Ohio AFWAL Jun. 1981 70 p
(Contract F33615-78-C-2058)
(AD-A111087; AFWAL-TR-81-2039) Avail: NTIS HC A04/MF A01 CSCL 10C

Interim results are presented for a program dealing with the placement of nickel-zinc batteries in specific military applications, namely the BQM-34A and the PQM-102 Remotely Piloted Vehicles. The nickel-zinc system was chosen for these applications because RPV's demand a high quality secondary battery that offers a compromise between long life (calendar and cycle) and low weight and volume. Program tasks include continued development of the nickel zinc system, calendar and cycle life testing of the two candidate batteries, qualification testing, and flight testing in operational RPV's. Test results of developmental cells and batteries include cycle life testing of various separator materials, high rate/low temperature discharges with various types of nickel electrodes, zinc electrode substrate, and charging methods. Calendar and cycle life testing is underway which will demonstrate the ability of the nickel-zinc system to be routinely cycled over an extended period of time. Author (GRA)

N82-26851# Nebraska Univ., Lincoln.
MEMBRANE-LINED FOUNDATIONS FOR LIQUID THERMAL STORAGE Final Report, 1 May 1978 - 31 Dec. 1979
R. C. BOURNE Jun. 1981 102 p refs
(Contract DE-AS02-78ET-20111)
(DE82-003651; DOE/ET-20111/1) Avail: NTIS HC A06/MF A01

The membrane lined storage (MLS) container which is a spinoff of vinyl-lined swimming pool and waterbed technologies was developed. The state of development of MLS was evaluated and concepts for MLS structural and heat transfer systems were improved. Preferred structural supports were identified and designed for 1500 gal MLS containers for basement, crawl space, and slab-on-grade foundation types. Techniques are developed to provide space heating via forced air through a finned storage jacket for the two preferred structural enclosure designs. Cost effectiveness of the direct air heating technique is evaluated. Alternate free convection domestic water preheaters and a preferred heat exchanger material is selected. Collector and space heat inlet/outlet designs, design concepts for auxiliary heat input to MLS from resistance electric, combustion, and heat pump sources are developed. DOE

N82-26852# Hittman Associates, Inc., Columbia, Md.
BATTERY RESOURCE ASSESSMENT. VOLUME 1: SCENARIOS, INVESTMENT, AND MATERIALS COST
D. SULLIVAN Jun. 1981 123 p refs
(Contract DE-AC02-80CH-10026)
(DE82-006243; DOE/CH-10026/2A) Avail: NTIS HC A06/MF A01

The possibility of widespread use of storage batteries for load leveling, photovoltaic, and electric vehicle applications creates a potential for major shifts in the utilization of various resources. In addition to materials requirements, significant investments will be required in order for the battery industry to manufacture a large number of batteries. A study to identify the resources required for a significant expansion of the battery industry and especially to note resources that may be strained as a result of accelerated battery development is presented. Scenarios of future battery demand, an analysis of battery manufacturing investments, an analysis of battery price sensitivity to materials prices, and an analysis of the availability of several key battery materials are included. DOE

N82-27691# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
TRANSIENT ANALYSIS OF HEAT TRANSMISSION SYSTEMS
G. E. PHETTEPLACE Dec. 1981 63 p refs
(Contract DA PROJ. 4A7-62730-AT-42)
(AD-A112365; CRREL-81-24) Avail: NTIS HC A04/MF A01 CSCL 20M

This report develops a method of analysis for heat transmission systems operating under district heating load conditions. The method accounts for the effects of heat source and load characteristics. The use of thermal energy storage systems is outlined and advantages are given. The transmission model itself considers the following technical aspects: (1) frictional pressure losses in piping system, (2) pump characteristics, (3) pump driver characteristics, and (4) heat losses from the buried piping. The capital costs considered are the piping system and necessary pumps. Operation and maintenance costs include cost of heat loss and cost of pumping energy input. Allowances are also made for system maintenance and repair over the assumed lifetime. GRA

N82-27749# California Univ., Livermore. Lawrence Livermore Lab.
DESIGN AND FABRICATION OF CONTAINMENT RINGS FR USE IN TESTS OF SIX PROTOTYPE FLYWHEEL ROTORS
A. P. COPPA (General Electric Co., Philadelphia) Feb. 1981 106 p refs
(Contract W-7405-ENG-48)
(DE81-030357; UCRL-15370) Avail: NTIS HC A06/MF A01

Containment rings were designed and fabricated to perform prototype flyheel rotor tests. Six open containment ring designs were developed based on the characteristics of six different rotors each with a particular failure mode. The containment requirements for each rotor and the designs developed are described. DOE

N82-27750# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France). Div. Systems Balistiques et Spatiaux.
MAGNETIC BEARING FLYWHEELS FOR ELECTRIC STORAGE
P. C. POUBEAU 1981 11 p refs Presented at Intern. Energy Agency Conf. on New Energy Conservation and their Commercialization, Berlin, 6-10 Apr. 1981
(SNIAS-821-422-110) Avail: NTIS HC A02/MF A01

A magnetic bearing flywheel was designed. In order to have a simple, reliable system, magnetic suspension with a single servoloop for one degree of freedom of the rotor was used, four other degrees of freedom being controlled passively and the sixth one, corresponding to the rotation axis. The motor that transfers electric energy to the rotor is of the ironless brushless dc type with electronic commutation. It is operated alternatively for accelerating the wheel and then as a generator for delivering the stored energy. The use of high stress composite materials in the rotor greatly increases the operational limits of this equipment. Key characteristics of kinetic energy storage are mentioned along with a wide range of applications. Besides energy storage for satellites, these include power smoothing for solar and wind energy systems as well as backup power supplies, e.g., for electric vehicles. Author (ESA)

N82-27751# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).
MAGNETIC SUSPENSION AND FLYWHEELS: SPACEBORNE AND TERRESTRIAL APPLICATIONS [LA SUSPENSION MAGNETIQUE ET LES VOLANTS D'INERTIE: APPLICATIONS SPATIAUX ET TERRESTRES]
P. C. POUBEAU 1981 4 p In FRENCH Presented at Conf. Aerospatiale a la Journee sur l'Espace et son Futur, Toulouse, Oct. 1981 Sponsored by SITEF
(SNIAS-821-422-111) Avail: NTIS HC A02/MF A01

Satellite attitude control, using inertia wheels, is discussed. Elimination of friction effects through application of magnetic bearings is considered. The inertia wheel/magnetic bearing configuration can also be used to store kinetic energy. Higher rotational velocities create a need for stronger rotor construction materials; improved mechanical properties can be achieved with composite materials. Kinetic energy storage for earthside applications (solar energy storage; electric vehicles) is mentioned. Author (ESA)

08

GENERAL

A82-28642
THE PRACTICAL UTILISATION OF FIBRE COMPOSITE HYBRIDS
W. PATON (National Engineering Laboratory, East Kilbride, Scotland) In: Fibre composite hybrid materials. London, Applied Science Publishers, 1981, p. 221-260. refs

The application potential and practical approaches to the design of hybrid components and structures are discussed and illustrated by examples of applications in automotive, aerospace, and energy

generation fields. Advantages in design and manufacture due to hybridization include increased structural stiffness, the possibility to control the coefficient of thermal expansion to match design requirements, high dimensional stability, corrosion resistance, and the possibility of accurate control of in-plane and through-thickness conductivity. Cost-effective hybridization depends on accurately matching laminate and reinforcement configurations within a product to an adequate performance specification; maximum structural utilization of the more expensive high performance phase is particularly important. V.L.

A82-29483
FRACTURE MECHANICS OF DUCTILE AND TOUGH MATERIALS AND ITS APPLICATIONS TO ENERGY RELATED STRUCTURES
H. W. LIU, (ED.) (Syracuse University, Syracuse, NY), T. KUNIO (Keio University, Yokohama, Japan), V. WEISS (Syracuse University, Syracuse, NY), and H. OKAMURA (Tokyo, University, Tokyo, Japan) The Hague, Martinus Nijhoff Publishers, 1981. 330 p $53

The evaluation, prediction, and calculation of failure processes in ductile energy related structures are examined. The J-integral is considered, including applications in estimations of structural strength, for cracks in nuclear reactor vessels, for fracture analyses of tough materials, for the development of plastic fracture mechanics capabilities, and for relationships between the J-integral and crack tip opening displacement. Experiments are reported with the J-integral being used for evaluating the crack tip plastic blunting and the elastic-plastic fracture, a semi-elliptical surface crack, and elastic-plastic toughness of irradiated steels. Stress, strain, and COD are discussed as fracture criteria, and the effects of material properties on fracture toughness are investigated. Finally, the fracture mechanics of creep and fatigue are explored, along with fatigue limits, notch sensitivity, and low cycle fatigue in metals. M.S.K.

A82-33029
FRACTURE STRENGTH OF SINTERED AND SILICONIZED SIC AND SIC JOINTS
G. G. TRANTINA (GE Research and Development Center, Schenectady, NY) American Ceramic Society Bulletin, vol. 61, May 1982, p. 555-558. Research supported by the Electric Power Research Institute. refs
(ACS PAPER 35-N-80)

Fracture strength properties that are related to the design of ceramic structures were evaluated. Sintered alpha SiC with a coarse microstructure exhibits more strength degradation at 1500 C than does alpha SiC with normal microstructure. The strength of a siliconized SiC can be increased by about 25% with a one hour/1200 C treatment and can be further strengthened (15-30%) by exposures to 1200 C and stress. Similarly, the strength of siliconized SiC joints can be increased by a one hour/1200 C exposure and further strengthened by exposures to 1200 C and stress. Both sintered alpha and siliconized SiC exhibit a size effect in the fracture strength that can be treated with a Weibull statistical approach. (Author)

N82-23137# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Zentralbereich Entwicklung.
RESEARCH AND DEVELOPMENT AT MBB. TECHNICAL AND SCIENTIFIC PUBLICATIONS, 1981 [FORSCHUNG UND ETWICKLUNG. TECHNISCH-WISSENSCHAFTLICHE VEROEFFENTLICHUNGEN 1981]
1981 193 p refs Partly in ENGLISH and GERMAN
Avail: NTIS HC A09/MF A01

Research and development work carried out during 1981 at Messetschmitt-Bolkow-Blohm GmbH, Ottobrunn, FRG is presented. Aerodynamics, materials science, infrared imagery, aircraft and spacecraft design, and production engineering are discussed. Calculation methods, mathematical and scale models, and computer aided design are treated. Solar energy and high speed trains were investigated.

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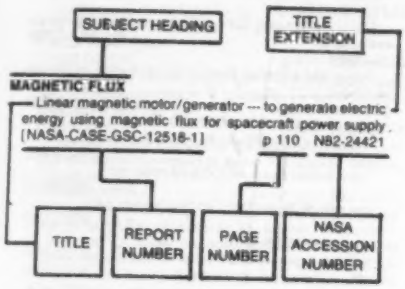

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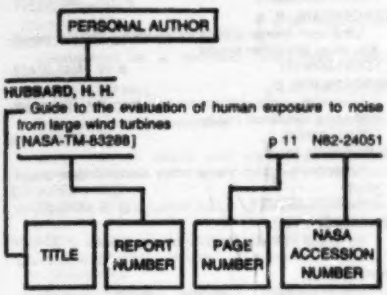

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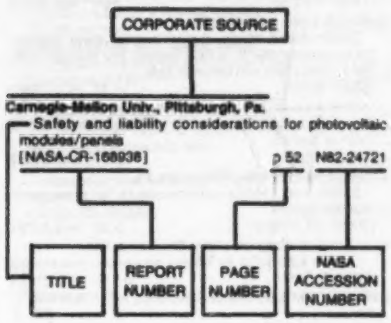

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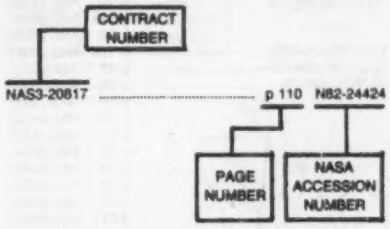

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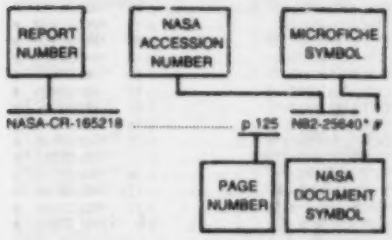

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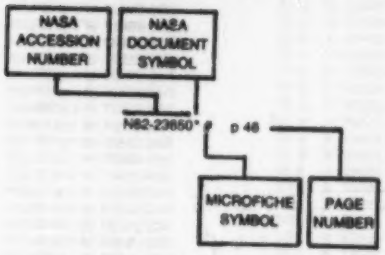

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